SIEMENS

# LITHOSTAR Multiline

## SP

## System Description

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*Document structure*

The system description was generated according to the following criteria:

- Empirical values recorded from function descriptions of previous versions

*Comments and suggestions*

The system description can always be improved since it is not necessarily complete in all aspects. Therefore, I hope there will be comments and suggestions from the field. As far as possible, I shall try to incorporate any comments and suggestions into the document.

Please write to me with your suggestions for improvement. Many suggestions, while they may appear improbable at the outset, can be the key to sudden "insight" for a service engineer.

Many thanks to all of you participating in the preliminary phase for your comments and suggested improvements.

.

Gunar Kneisl TDF 1

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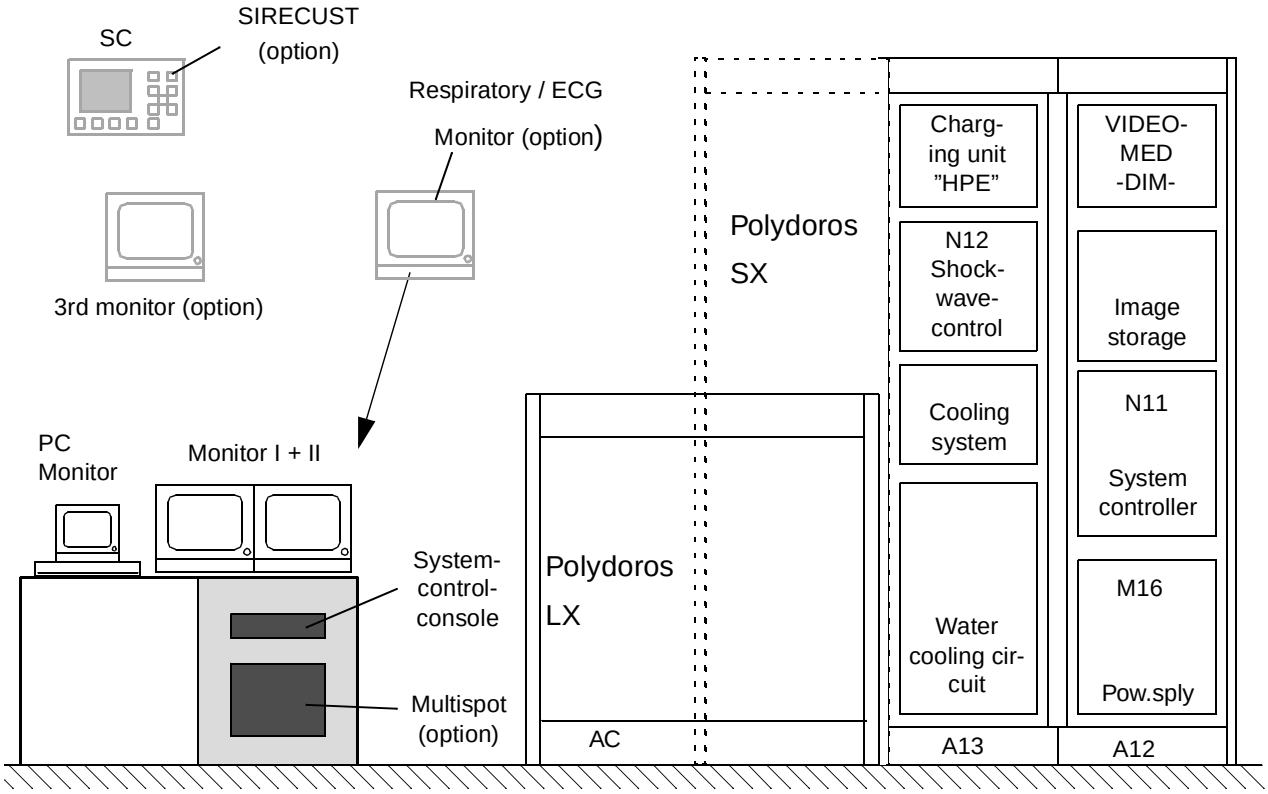
| NOTICE | **All voltages in the document are typical values and are not intended to be used for adjustments.**<br>**Always use the current Maintenance Instructions for any adjustments required.** |
|---|---|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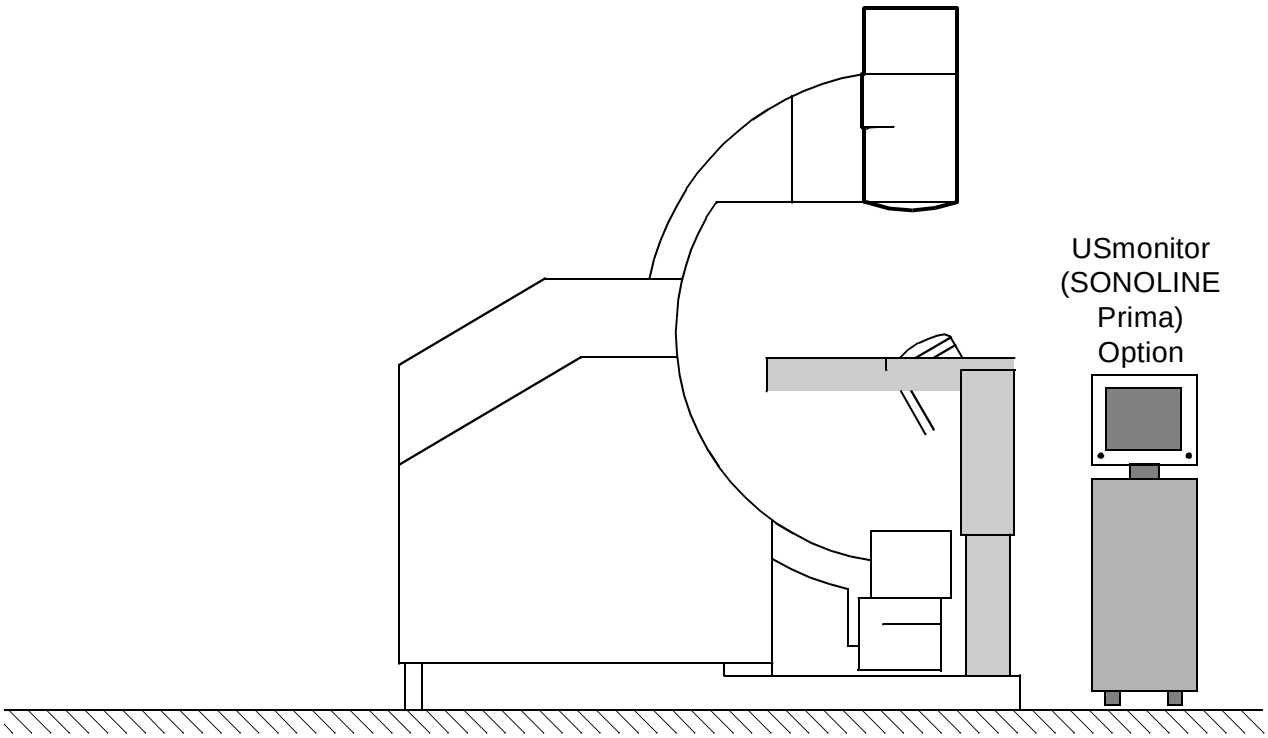
USmonitor
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Option

## General

*Universal work station*

The "LITHOSTAR Multiline system" is a multifunction workstation for diagnosis and therapy involving extracorporeal shock wave lithotripsy with radiographic and optional ultrasound imaging. The system is excellent for the treatment of stones throughout the entire urinary tract as well as for all suitable auxiliary treatments required.

*Positioning*

Laser light localizer for prepositioning the patient

*C - arm*

The system includes an undertable X-ray unit permanently mounted on a C-arm. In addition to conventional use of the system for diagnostic purposes (0°), the C-arm can be moved orbitally for the purpose of stone localization (-10°/30°).

*Localization*

The focal point of the shock wave head (maximum shock) is located in the center of both localization ranges (isocenter). Inline technology enables observation of stone fragmentation through the shock wave source.

*US localization*

Additional stone localization is made possible via the ultrasound monitor by inserting an ultrasound probe in the shock wave head (Inline Position).

*System control*

The system is controlled at a control console via a PC with keyboard and mouse as well as a tableside control. A tableside control is also available on the patient table. The table can be lowered to 720 mm to provide comfortable access for the patient.

*US control*

A tableside control is located on the Ultrasound unit for important functions such as: probe movement, shock wave release, shock wave counter, probe angle display.

*Documentation*

Hardcopy documentation is also possible using film
(cassette size 35 x 43 cm) via an insertable cassette holder.

*“Work authorization”*

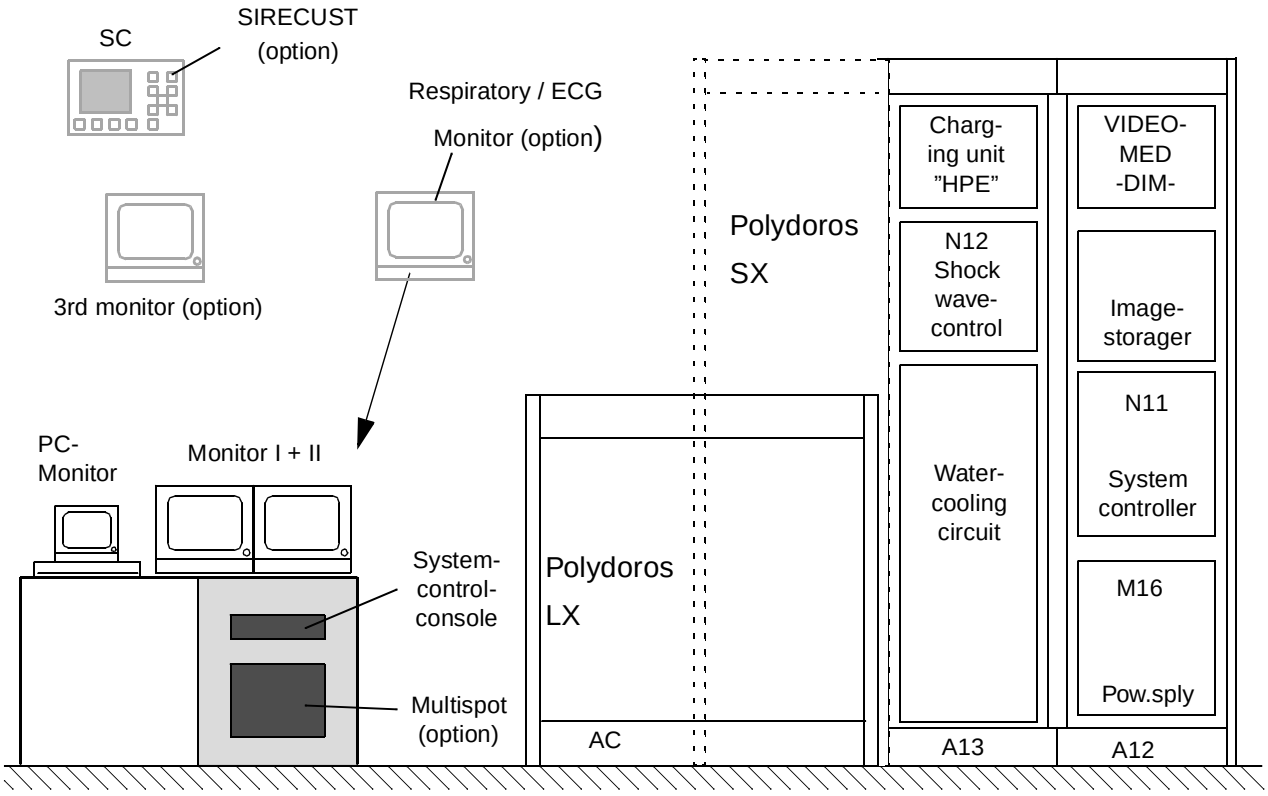
To guarantee system functions, only service engineers with work authorizations for the LITHOSTAR Multiline may service this system.

*Operating modes*

Two operating modes are possible:

| | |
|---|---|
| Diagnostic mode | (table insert locked in) |
| Therapy mode* | (table insert removed) |

*with X-ray or ultrasound localization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Respiratory / ECG
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3rd monitor (option)
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N12
Shock
wave-
control
Water-
cooling
circuit
VIDEO-
MED
-DIM-
Image-
storager
N11
System
controller
M16
Pow.sply
PC-
Monitor
Monitor I + II
System-
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Multispot
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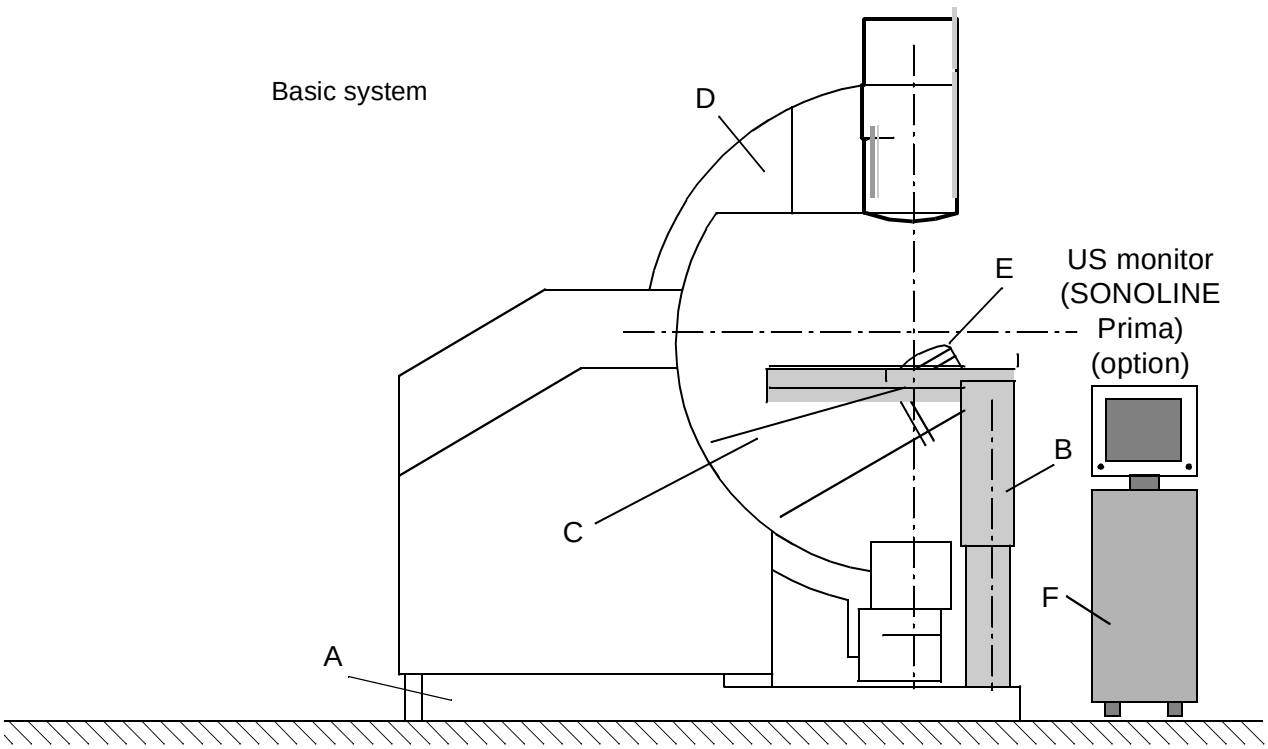
Polydoros
LX
AC
A13
A12


Basic system
D
E
US monitor
(SONOLINE
Prima)
(option)
B
C
F
A

## System components

*Basic versions*

- System type 1----- LITHOSTAR Multiline
- System type 2----- LITHOSTAR Multiline Pro
- System type 3----- LITHOSTAR Multiline Uro Plus

*Main system features*

In addition to the features of system types 1 and 2, system type 3 features a different X-ray generator and image intensifier.

- System types 1 and 2:------with POLYDOROS LX and 23cm I.I.
- System type 3:---------- POLYDOROS SX / 33cm I.I.

*Notice:*

For additional details, refer to the data sheets.

The ultrasound option can be installed in all of the systems.

*Basic system*

A: **Basic frame**

System longitudinal movement

Drives, table lift / tilt, longitudinal movement, footswitches

B: **Patient table**

Two lifting columns, tabletop carrier, tabletop

Uro insert, head extension, foot extension, tableside control panel

C: **System carrier**

Support frame, C-arm support, shock wave system support, C-arm orbital drive, shock wave system drive, system transverse movement drive

D: **C-arm**

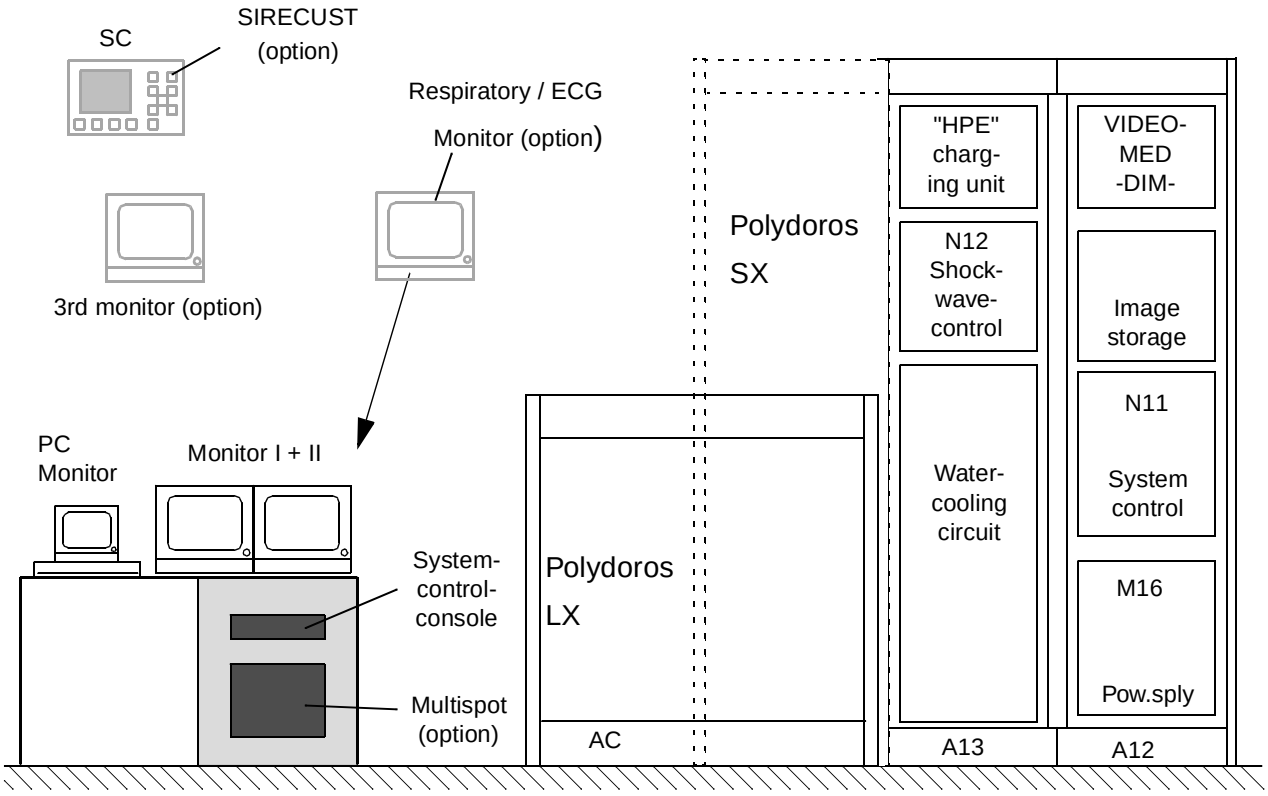
I.I. / TV system, adapter unit, X-ray tube assembly

Collimator N

E: **Shock wave system support**

Shock wave head M, System carrier, Shock wave generator, coupling system

F: **Ultrasound unit**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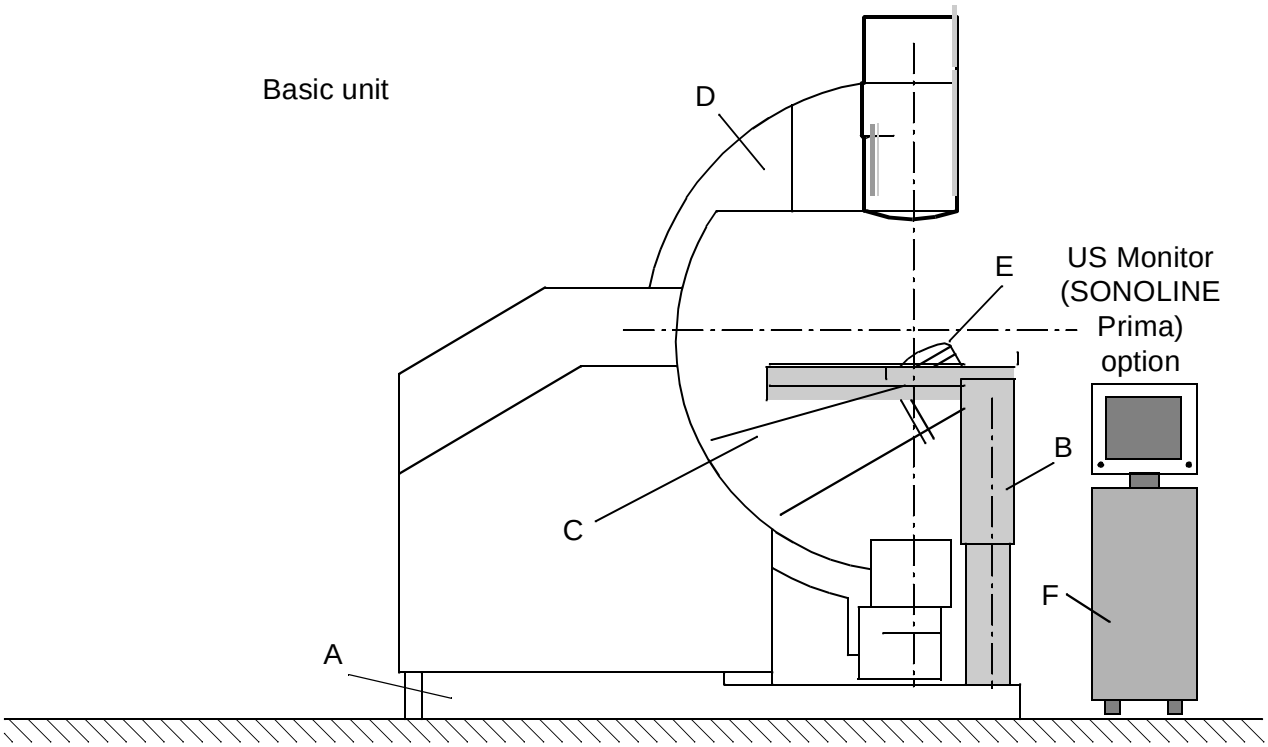
Basic unit
D
E
US Monitor
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option
B
C
F
A

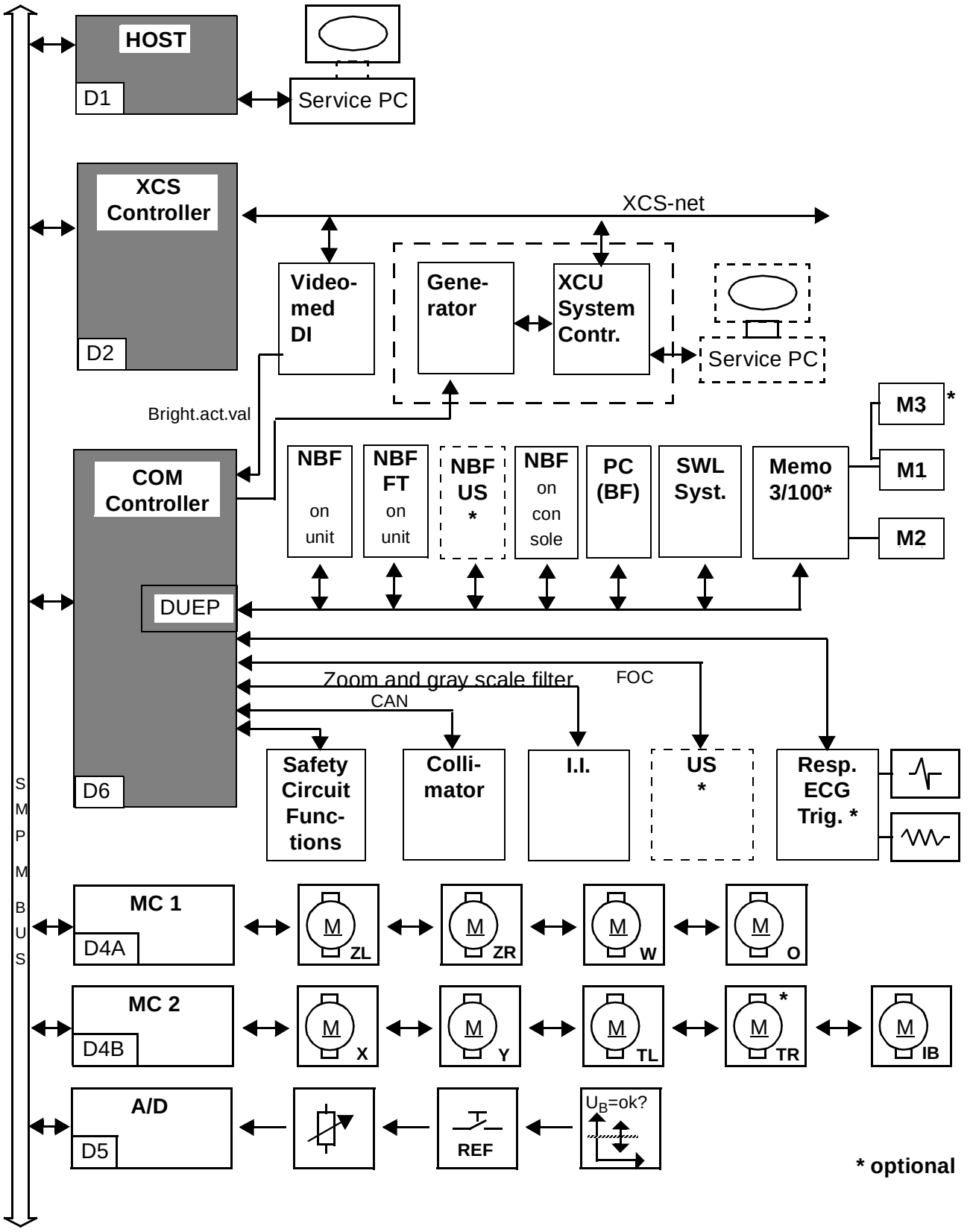
*Shock wave cabinet A 13*

- Charging unit HPE
  Supplies high voltage to the shock wave generator.
- Shock wave control
  Coordinates and monitors shock wave release and data transmission to the main processor (HOST). The water process controller is included in this cabinet.
- Water cooling circuit
  Cools the water heated by the shock wave head (E) in the cooling circuit. The mechanical parts such as valves, filters, hose interfaces, etc. are contained in this unit.

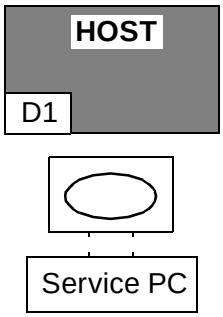
*Control cabinet A 12*

- Image storage
  Stores the image signals in the Fluoroscopy and snap shot modes*. The Memoskop 100-L can store up to 100 images.
- Videomed DI -M
  TV system with 50/60 Hz 625/525 lines. The image acquisition system (the camera) contains a CCD chip. "M" stands for motor-controlled iris diaphragm (controlled by the Host via the Motor end stage D4).
- System control
  Consists of various components for control and monitoring of the entire system (refer to the block diagram, page 1-8).
- Power supply
  Power supply for the basic system and controls.
  Also contains the elements of the safety circuits.

*optional


HOST
D1
Service PC
XCS Controller
D2
XCS-net
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
COM Controller
NBF on unit
NBF FT on unit
NBF US *
NBF on con sole
PC (BF)
SWL Syst.
Memo 3/100*
M3 *
M1
M2
DUEP
Zoom and gray scale filter
FOC
CAN
D6
Safety Circuit Func-tions
Colli-mator
I.I.
US *
Resp. ECG Trig. *
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M * TR
M IB
A/D
D5
REF
UB=ok?
* optional

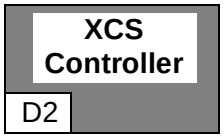
## System controls




TASKS:

System control and system monitoring
(System start, hardware tests, Service PC interface
Data communication to the external units (via D2 and D6)
(Establishes contact with the XCU in the X-ray generator)
Simulates functions of generator operation and TV system (via D2).
(FE = Funktionseinheit (function unit).
Manages errors via a four-digit error code system.

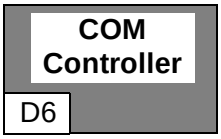
The service PC interface is located on the HOST board



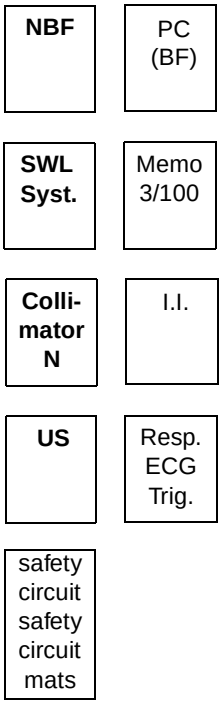

The XCS Controller (X-Ray Communication System) acts as

an interface to the XCS network (serial communication system).

The Host communicates with the XCU via the XCS Controller.
(X-Ray Controlling Unit). The XCU is located in the POLYDOROS generator.




This is the central interface module for communication between the HOST(D1) and the function units connected.




**1)** Serial interfaces DUEPs (Data transmission protocol) to the:

- Operating PC.....(PC)
- System and Ultrasound tableside control panel, system footswitch.....(NBFG, NBFUS*, NBFFT)
- Water system and shock wave release....(SWL Syst.)
- Image storage.....(Memoskop 3/100)
- Control console.....(NBF)

**2)** Serial interface for collimator N via CAN (Controller Area Network)

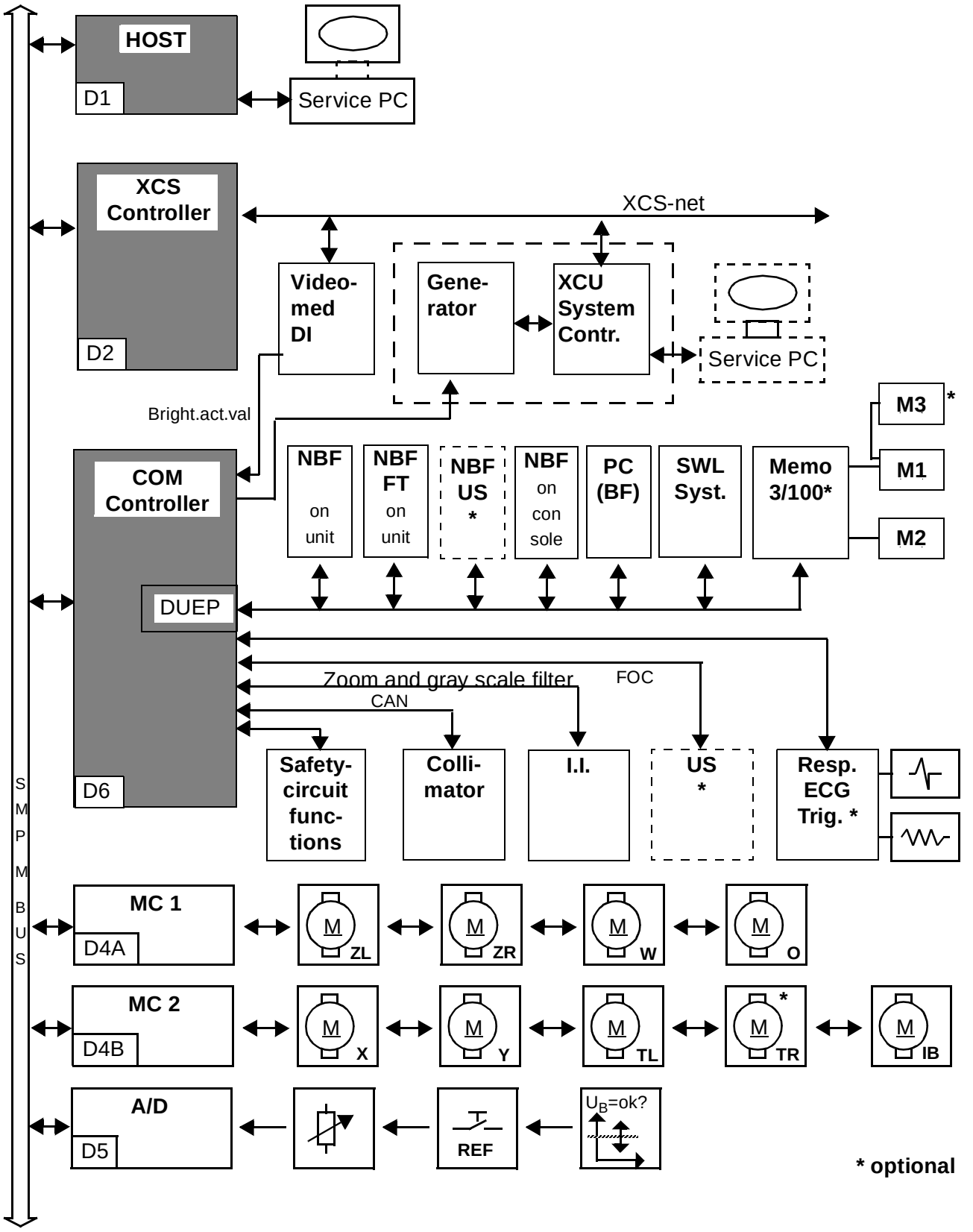
**3)** I/O Interace for image intensifier I.I. (Zoom selection)

**4)** I/O Interface for Ultrasound SONOLINE Prima

**5)** Serial interface for respiratory and ECG Triggering

**6)** additional in/output ports are available to the Host for **monitoring and control of:**

- the safety circuit and the safety circuit mats
- reference switches for the drives
- cassette exposures, FL, prep, main release
- image memory (Memoskop), shock wave release, etc.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D6
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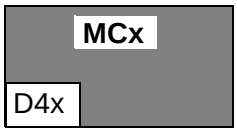
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M TR *
M IB
A/D
D5
REF
UB=ok?
* optional

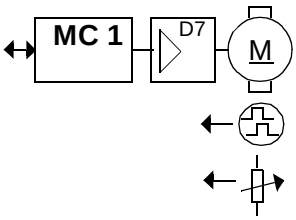
## Block diagram

| Motor controller MC1 | | | Motor controller MC2 | | |
|---|---|---|---|---|---|
| ZR: | Right lifting column | AM1 | X: | System transverse drive | AM5 |
| ZL: | Left lifting column | AM2 | Y: | System longitudinal drive | AM6 |
| W: | Shock wave head | AM3 | IB: | Iris diaphragm | AM7 |
| O: | Orbital (C-arm) | AM4 | TL: | Cone longitudinal drive | AM8 |
| | | | TR: | Cone rotation (optional) | AM9 |

TASKS:

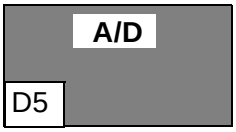



- MC: The motor controller controls or regulates the system motors. Commands for the motors are transmitted via the Dualport RAM of the HOST (D1). Two motor controllers are used. Each one can control a maximum of five motors.




**NOTICE**

**The motors are controlled via timed motor end stages. (D7..).**
**An encoder and a potentiometer are used to communicate the current movement and position of the motor.**




- A/D: Converts the analog input voltage of the actual value potentiometer and the operating voltages.
- Queries the reference switches.

There are 16 channels with 10 bit resolution and 16 digital inputs available.

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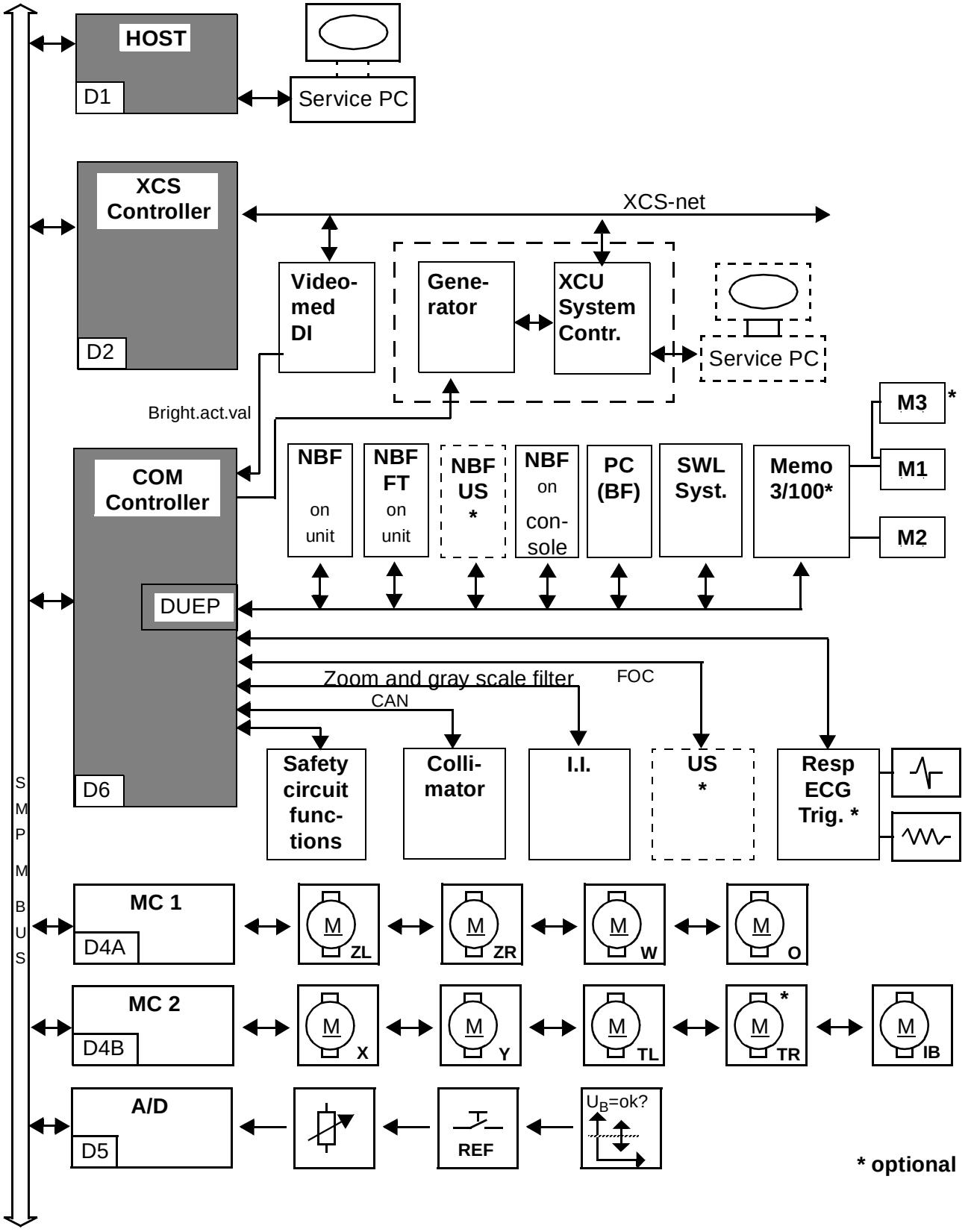
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M W
M O
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M X
M Y
M TL
M TR
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* optional

## Operating PC

*Components*

- Central unit
- Monitor
- Keyboard
- Mouse

*Communication*

Data transfer between the operating PC and the COM controller takes place via a serial DUEP interface, which is located on the ADC/DUEP PC D51 plug-in board. The D51 acts as a DUEP slave (pp 2-6) compared to the COM controller.

Data transfer between the PC and DUEP slave via the AT-Bus of the PC.

*D 51 Tasks*

- Communication with the Com-Controller D6 via the DUEP 2 interface
- Communication with the PC-AT-Bus via the Dual-Port Ram interface

*D51 Displays*

1 seven segment, 1 Watch dog reset, 1 boot mode
1 life sign AT-Bus, 1 life sign DUEP.

*Initialization*

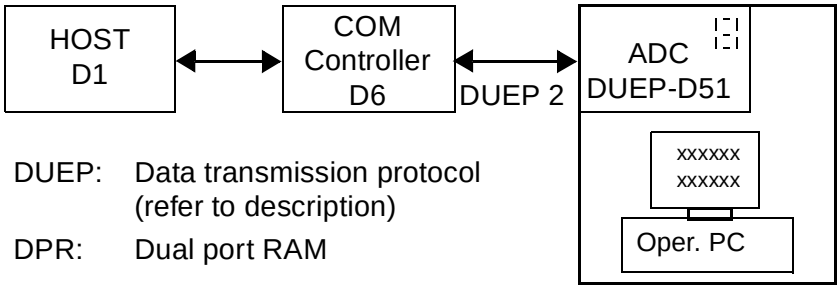
Tests the hardware, initializes the components, establishes contact with the HOST and with the operating PC.

*Seven-segment Display.*

*Visible only when the PC housing is open*

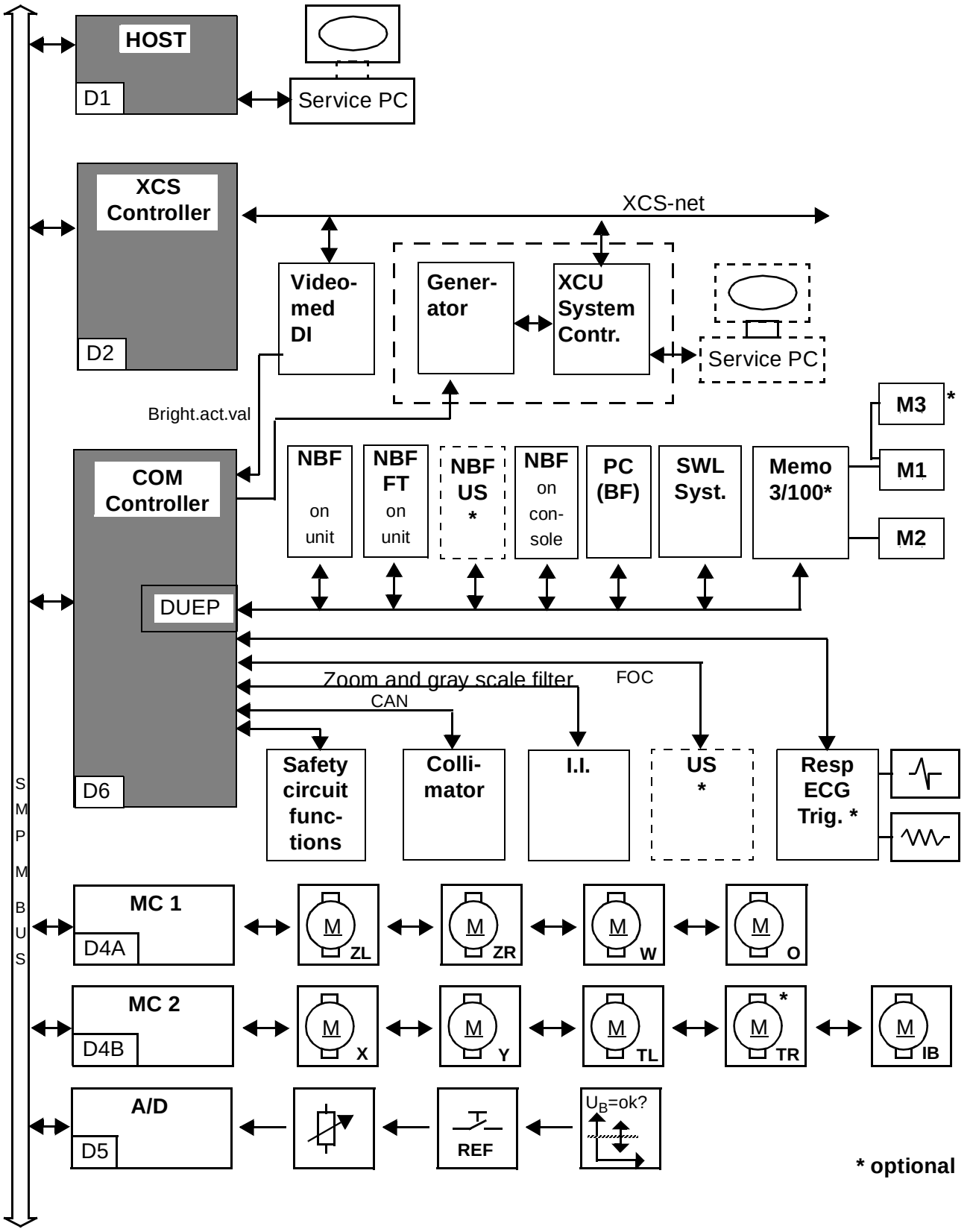
0: Normal mode
1: DUEP communication error, DPR ok
2: DPR communcation error, DUEP ok
3: DPR and DUEP communication error
4: Error in the analog component
5 Clock error
5: External RAM error
7: EPROM or program RAM error
8: Error-free initilization but no DPR contact & no DUEP contact
9: n.c.

DP: Decimal point flashes; 80C535 µP vital sign




DUEP: Data transmission protocol (refer to description)

DPR: Dual port RAM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US *
Resp ECG Trig. *
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M TR *
M IB
A/D
D5
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UB=ok?
* optional

## Main control panel and tableside control panel

*Tableside control panel*

In addition to the PC operation, some operating functions are available directly at the system. These operating functions are limited to system functions and functions for urological examinations (image storage, zoom etc.). In addition, the tableside control panel on the PC, the tableside control panel on the unit, the system footswitch and the US tableside control panel may also be used.

*Communication*

Data transfer between the operating panel and the COM controller takes place via a serial DUEP interface.

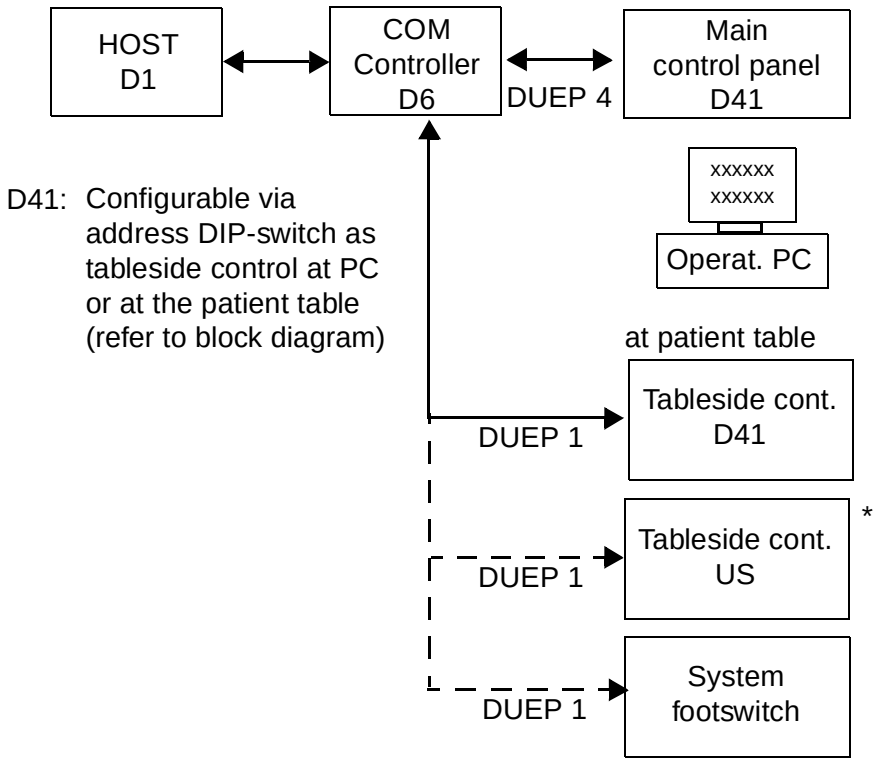
| | |
|---|---|
| Tableside control (console) | → DUEP 4 |
| Tableside control (unit) | → DUEP 1 |

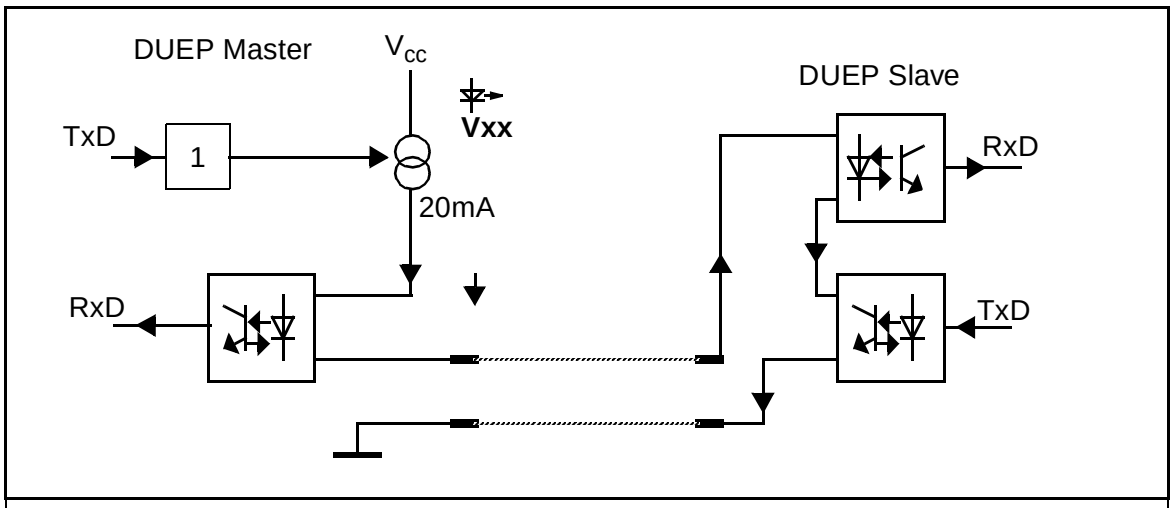
*Initialization*

The most important tasks are: basic initialization and hardware tests and time-out monitoring (establishing contact). Error handling is important when service work is being performed.

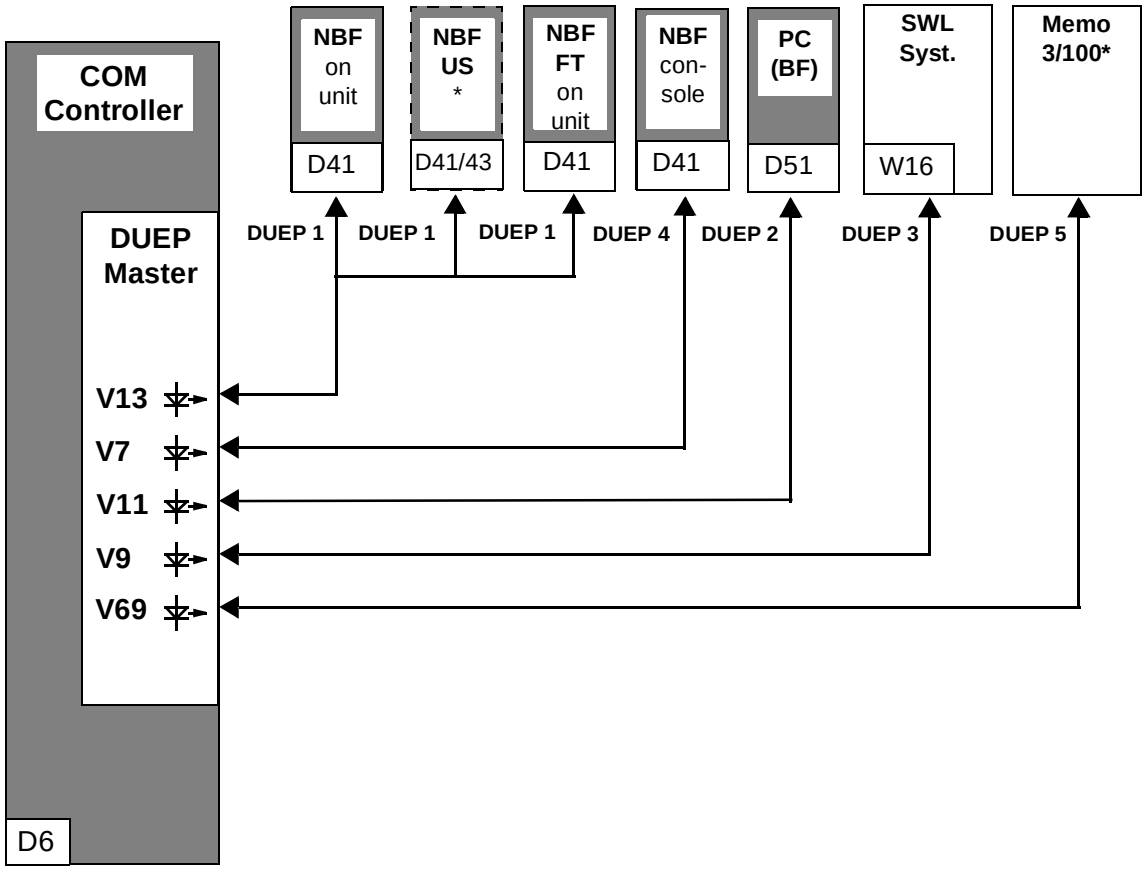
*Error handling Tableside control panels*

| | |
|---|---|
| Hardware errors: | LED's flash in all keys. (approx. 5 Hz) |
| Establishing contact: | Initial contact. LED's flash sequentially in keys |
| Polling time out: | LED's in all keys flash. (approx. 1 Hz) |






Function principle of DUEP interface



## DUEP Interface

*DUEP*

Serial data transmission between the master (Com controller D6) and the slaves (e.g. operating panels or image memory, etc.) occurs via a Siemens-standarized data transmission protocol (DUEP).

The DUEP interface is a 20mA current loop.

Each current loop has an LED as indicator on board D6.

If the LED is "ON", it means: the loop is connected and 20 mA are present.

**DUEP 1: Current loop 1 Tableside controls (system, US unit, NBFFT)**
**DUEP 2: Current loop 2 Operating PC**
**DUEP 3: Current loop 3 Shock wave system**
**DUEP 4: Current loop 4 Tableside control at the PC**
**DUEP 5: Current loop 5 Image memory**

*Function*

Telegrams containing commands to be performed are sent via these current loops (e.g. selecting functions or increasing values etc.). Even if no commands are present, the COM controller (D6) continuously checks the function of the interface. If no signs of life are present, the COM controller transitions to a security level and sends a failure message to the Host (D1). An error message is displayed.

*Possible causes of error*

Connection to the slave has been interrupted (e.g. damaged cable). The LED goes out.
Connection to the slave has shorted out.
Assembly for respective DUEP is defective.

**NOTICE**

**The service engineer (FSE) can deactivate slaves via the service program. This can be useful during error localization. This method should, however, only be initiated by experienced service engineers. For example, it is typical to see the LED's flash sequentially in the operating keys if initial contact from the operating panel (D41) to the master (D6) does not occur.**

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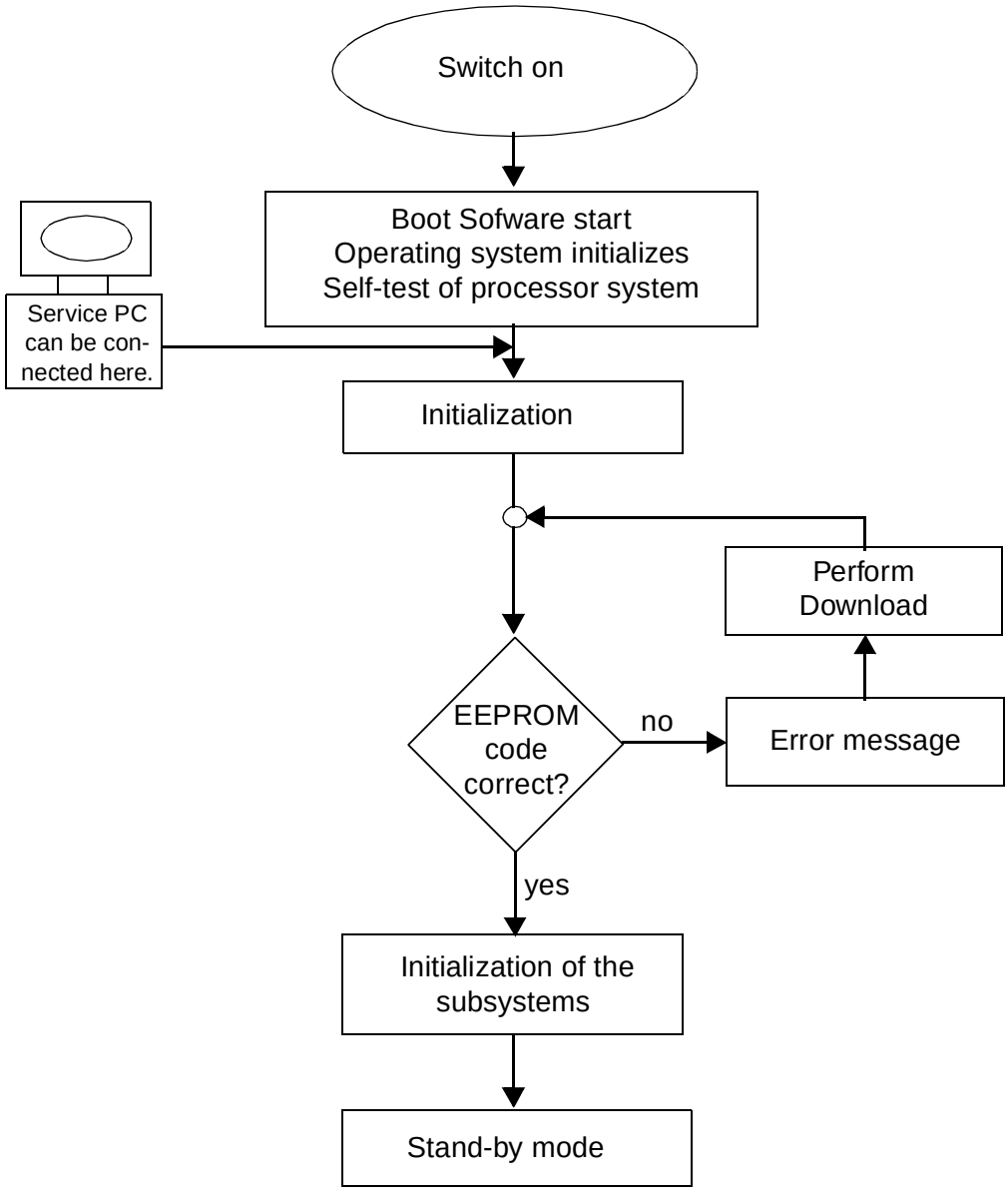

Switch on
Boot Sofware start
Operating system initializes
Self-test of processor system
Service PC can be connected here.
Initialization
Perform Download
EEPROM code correct?
no
Error message
yes
Initialization of the subsystems
Stand-by mode

## Simplified program sequence

*Switch on/ Switch off*

| | |
|---|---|
| In normal cases: | at the control console. Key S30 switches ON and key S31 switches OFF. |
| In case of service: | at the generator at D160. Key S1 switches ON and switch S2 switches OFF. |

**NOTICE** **Switching the system off from the generator provides additional safety for the service engineer because the system cannot be switched back on from the control console.**

*Initialization*

**Step 1:**

- Starts boot software
- Initialize operating system
- Processor system self-test

Simply stated, this first step initializes and tests the HOST board D1.
All subsystems are initialized in parallel.

*Service PC*

**The PC can be connected following completion of the first step.**

**Step 2:**

- Starts initialization tasks

The version number of the HOST software is compared with the version number in the EEPROM.

*Download*

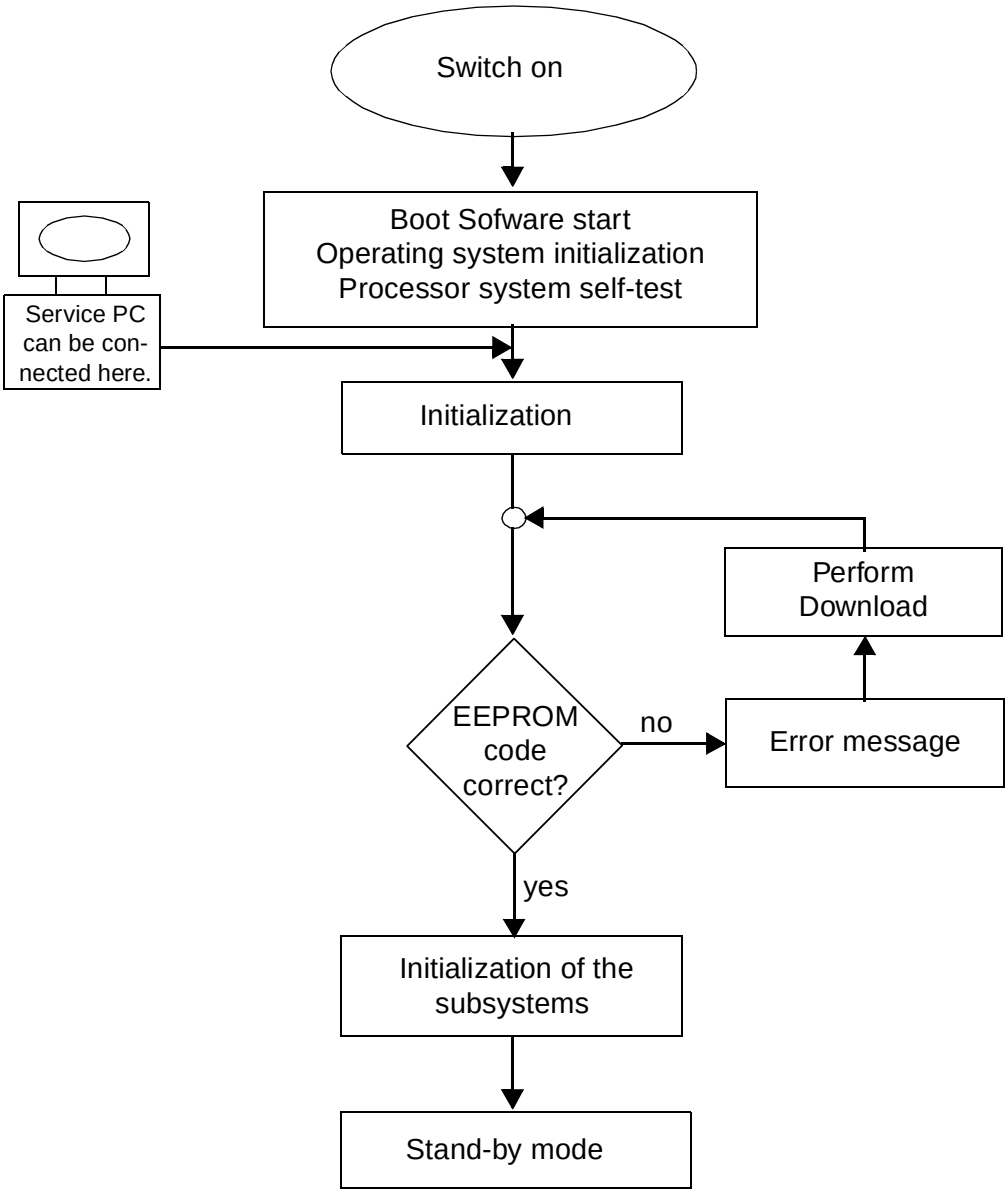
If there is a discrepancy, the HOST will send an error message and will transition to a wait loop. Only by downloading the operating software in the EEPROM is it possible to continue the initialization.

*Establishing contact with the subsystems*

**Step 3:**

- Initialization routines of the subsystems

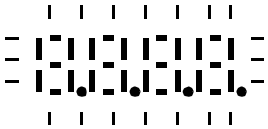
Contact with the subsystems is established in this part of the initialization. In principle, the subsystem must contact the HOST after initial contact is established and vice versa.
As a rule, three attempts will be made to establish contact to the other if errors occur during this data exchange. If these attempts fail, the systems will transition to a security level and an error message will be displayed.


Switch on
Boot Sofware start
Operating system initialization
Processor system self-test
Service PC can be connected here.
Initialization
Perform Download
EEPROM code correct?
no
Error message
yes
Initialization of the subsystems
Stand-by mode

**The 7-segment displays during system initialization.**

*HOST*

**D1:**



*V1,V7 on*

- All four 7-segment displays and decimal points light up after switching the system on or after a system reset.
  LED V1 (green) and V7 (red) are on.

**0.0 0 0**

*V1,V7 on*

- Four ’0’s are then displayed with a flashing decimal point. V1,V7 on.

**0.0 0 0**

*V1 on*

- At the end of initialization, the four ’0’s, a flashing decimal point and V1 are on.

*RESET*

- When activating the RESET switch, D1 reinitializes.

*COM Controller*

**D6:**

- All displays and decimal points light up.
- Afterwards,→**50**→**20**→**40**→**10**→**30**→**55**→**36**→**55** and a flashing decimal point appear.

**5 5.**

- Two ’5’s and a flashing decimal point indicate:
  STATUS NORMAL.

*XCS Controller*

**D2:**

- All display segments light up. Afterwards, two ’0’s and decimal point of LED V2. Then→**00**→**31.**→**60.**→**31.**→**61.**→**30.**→**61.**→**00**.

**NOTICE**

**In the case of errors, these are the most important boards to be monitored during initialization.**
**The normal condition for all boards is: ”Displays at 0 and flashing decimal points”.**

**If the US option is not present, "55" and "60" will also be displayed.**

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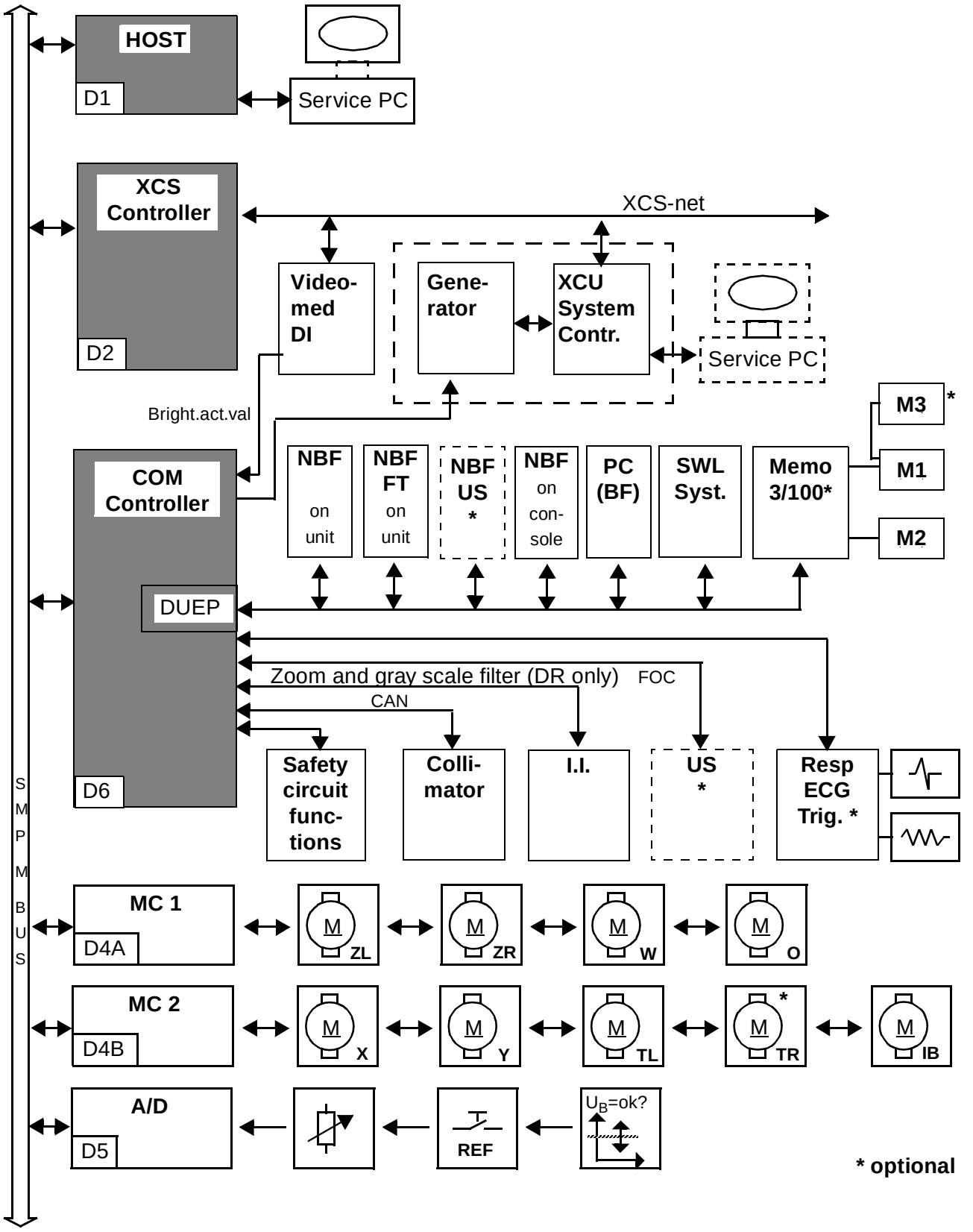

HOST
D1
Service PC
XCS Controller
D2
XCS-net
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
M3 *
M1
M2
COM Controller
NBF on unit
NBF FT on unit
NBF US *
NBF on con-sole
PC (BF)
SWL Syst.
Memo 3/100*
DUEP
Zoom and gray scale filter (DR only)
FOC
CAN
D6
Safety circuit func-tions
Colli-mator
I.I.
US *
Resp ECG Trig. *
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M TR *
M IB
A/D
D5
REF
UB=ok?
* optional

## Overview

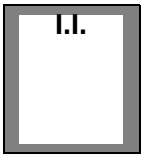
*Task*

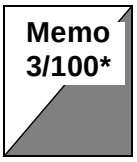
**Controls the following components:**

- Relays in the safety circuit on board D21
- Start and Download signals for the image memory
- Signals for zoom levels
- Safety switches
- Respiratory gating learning phase and respiratory trigger ON/OFF
- Move gray scale filter IN/OUT

**Reading in information:**

- Safety circuit signals (collision protection)
- Limit switches for the drives
- Reference switches
- Cassette switch for exposures on film (Direct Radiography) and cassette holder present
- Shock wave release
- FL, Prep, Main release
- Aquisition in progress from image memory
- US probe in shock wave head
- Cone pressure switch






*Errors*

If an error occurs, it will be displayed and the corresponding action released.

*Safety circuit*

The safety circuit (large and small drives) can be interrupted by activating the emergency shutdown buttons, collision protection switches or the safety limit switches.

*Reference switches*

The reference switches monitor defined positions of the drives. (Refer to the chapter on motor control).

*A/D converter*
*Power-supplies*

Via the A/D converter, various voltages are tested against the nominal values and values of the potentiometer positioned on the motor axes are read in.
The following voltages are checked:

- System drives
- Small drives
- +5V / +24V

| NOTICE | **The safety, monitoring and control circuits are explained in greater detail in the individual chapters. The port signals are accessible via the service PC.** |
|---|---|

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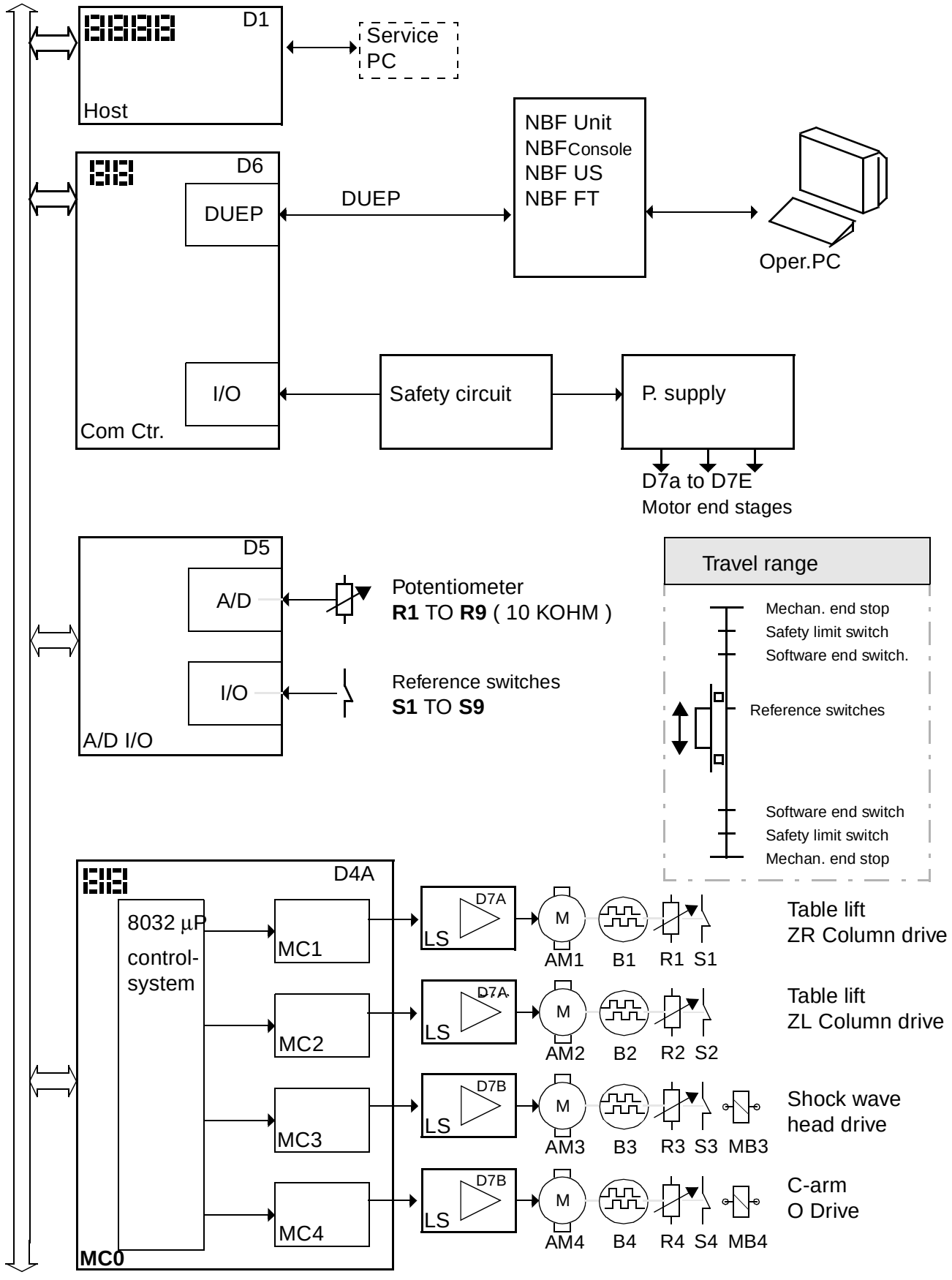

D1
Host
Service PC
D6
DUEP
DUEP
NBF Unit
NBFConsole
NBF US
NBF FT
Oper.PC
I/O
Com Ctr.
Safety circuit
P. supply
D7a to D7E
Motor end stages
D5
A/D
I/O
A/D I/O
Potentiometer
R1 TO R9 ( 10 KOHM )
Reference switches
S1 TO S9
Travel range
Mechan. end stop
Safety limit switch
Software end switch.
Reference switches
Software end switch
Safety limit switch
Mechan. end stop
D4A
8032 µP
control-
system
MC1
MC2
MC3
MC4
MC0
D7A
D7A
D7B
D7B
LS
M
AM1
B1
R1
S1
AM2
B2
R2
S2
AM3
B3
R3
S3
MB3
AM4
B4
R4
S4
MB4
Table lift
ZR Column drive
Table lift
ZL Column drive
Shock wave
head drive
C-arm
O Drive

## Overview

*General*

By **activating a key on the control panel** (tableside or operating PC ) a command is activated (FB) and the following occurs:

*Movement command*

- ➪ Via the DUEP interface and the Com Controller D6, the movement command goes to the HOST D1.
- ➪ The Host forwards the command, speed to the responsible motor controller (D4A, D4B).
- ➪ The motor controller activates the motor via the end stage D7x and the movement begins.

*Relative current position*

- ➪ An incremental transmitter (Bx) connected to the motor axle reports the current position (MC value). The motor controller transmits this actual value to the HOST for further evaluation.

*Absolute current position*

- ➪ At the same time, the potentiometer that acquires the system position is also turning. The analog value produces the absolute actual value of the potentiometer after conversion in the A/D converter (D5). This ADC value is read out by the Host at regular intervals.

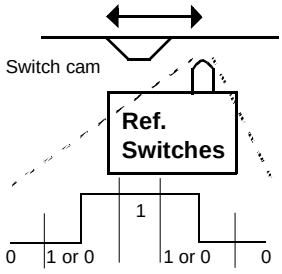
*Travel range*

The travel range is limited by means of software limit switches (SE) and safety limit switches (refer to the safety circuit).

*SE*

This value is determined in the testing field and cannot be changed by the service engineer.

*Reference switches*




acceptable values in test range

The reference switches (S1-S9) are necessary only to monitor the potentiometers. They are located at certain points within the travel range ( e.g. system longitudinal travel zero position, etc.) and are activated by a switch cam, e.g. each time the drive passes the switch cam. When the HOST receives the message via the I/O port (D5) ” Ref.switch on”, it checks the current actual value of the potentiometer where the value is stored for this reference switch.

**THIS IS OF GREATEST IMPORTANCE IN THE THERAPY POSITION.**

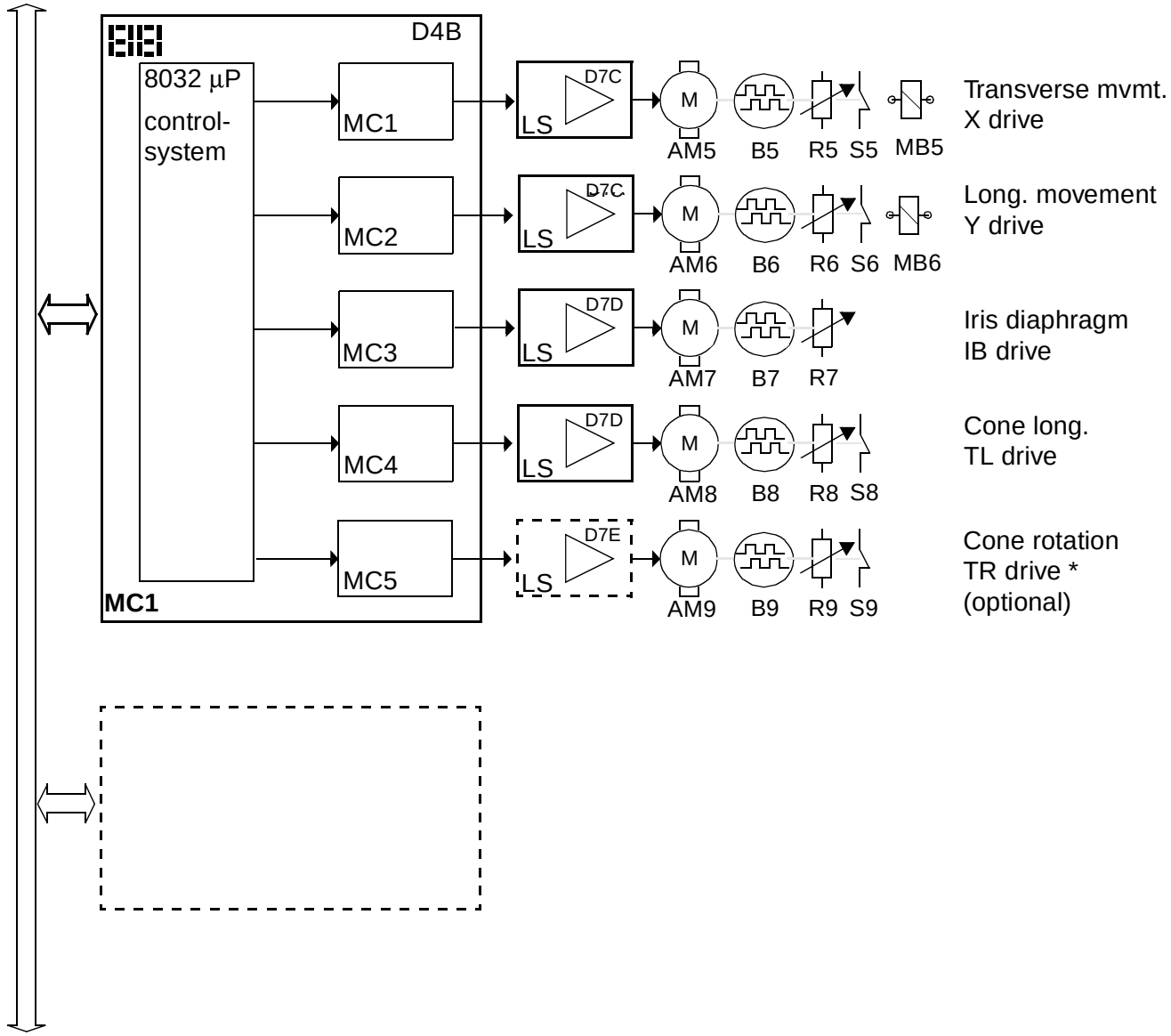
**In the therapy position, the shock wave focus must coincide with the cross hairs target.**

*possible errors*

The HOST basically recognizes hardware errors or communication errors between the processor systems.

If a motor, an actual value potentiometer or an encoder is defective, the HOST immediately issues an error message. For example:

- ➪ The difference between the **ADC value** and the **MC value** is too large (two-channel acquisition).


D4B
8032 µP
control-
system
MC1
MC2
MC3
MC4
MC5
MC1
LS
D7C
D7C
D7D
D7D
D7E
M
AM5
B5
R5
S5
MB5
AM6
B6
R6
S6
MB6
AM7
B7
R7
AM8
B8
R8
S8
AM9
B9
R9
S9
Transverse mvmt.
X drive
Long. movement
Y drive
Iris diaphragm
IB drive
Cone long.
TL drive
Cone rotation
TR drive *
(optional)

*possible errors*

- ➪ or the potentiometer value deviates from the reference switch nominal position
- ➪ or the Rx potentiometer has a broken wiper, etc.

The error message is read out at the HOST (D1).

*Notice*

There are certain important items that the service engineer **must know**:

1) After executing a switch-on or Reset, the values **ADC position = MC position** must be identical in the service program: DIAGNOSTIC / MONITORING.
The operating software sets the first position value (starting value) for the motor controller (MC position) based on the actual value of the potentiometer supplied by the A/D converter (ADC position). Thereafter, the encoder supplies the difference between the actual position and the current position. The encoder can measure only relative values.

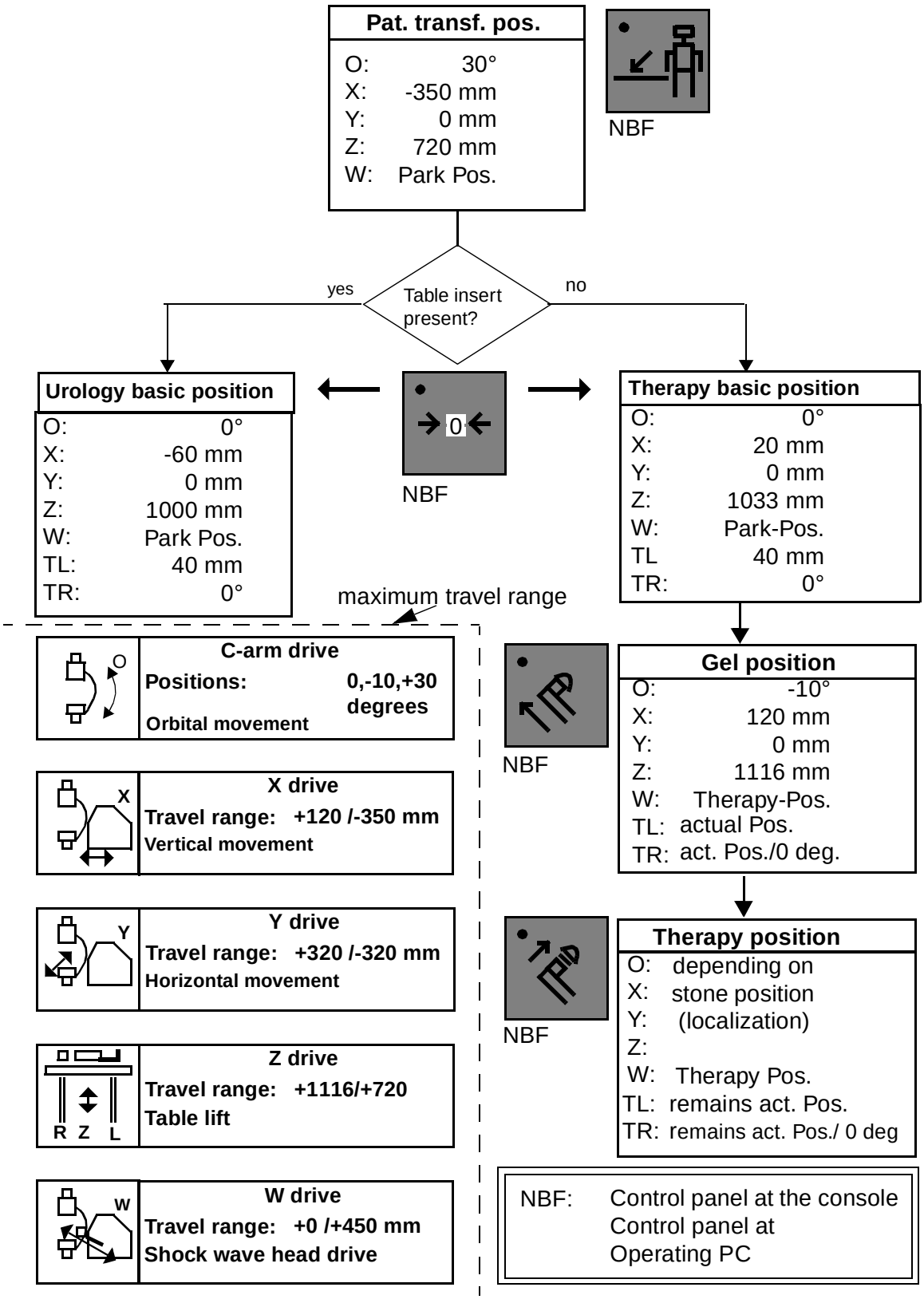
2) In the service program menu **"ADJUSTMENT/CALIBRATION"**, there is an **"UNREGULATED MODE"** selection that allows the motor to be moved without feedback signals from the potentiometer or the encoder. The selected motor will move at reduced speed in this operating mode (can be adjusted via the service PC).
This operating mode is used for calibration and for error removal (e.g. drives in the safety circuit).

*Safety information*

**Use CAUTION when operating the system in "UNREGULATED MODE". A collision can easily occur since the monitoring functions are disabled. Watch all moving parts of the system.**

| NOTICE | **The reference switches are not monitored in urology mode (table insert). In case of an error, e.g. reference switches not ok in therapy position, you can switch over to urology mode and move out of this position after performing a system reset.** |
|---|---|

**Displays for important system positions on the operating monitor**




*TL/TR: refer to the chapter :Ultrasound function unit*

## Important system positions

*Patient transfer position*

This system position allows the patient easy access to the table. The image intensifier has been moved as far as possible out of the range of the table. The HOST always knows the actual position values of the motor drives and automatically steers the drives in the correct direction after comparison with the ascending parameters.

**Releasing the drives in the patient transfer position**
The basic system position is released. The LED in the tableside control panel key flashes.

**Drives required for the patient transfer position**
In the worst case, the HOST activates the following drives:
(X,Y,ZR,ZL,W,O,TL,TR*,)

*Basic positions*

There are two basic positions:

- The basic position for urology mode
- The basic position for therapy mode

Table insert installed: Urology mode
Table insert not installed: Therapy mode

**Basic position indicators for Urology mode**

- Working table height for Urology mode (Z = 1 000mm)
  (Travel range 900 - 1100)
- C-arm in the 0° position (Travel range -10° / +10°)
- Shock wave head in park position
- System carrier

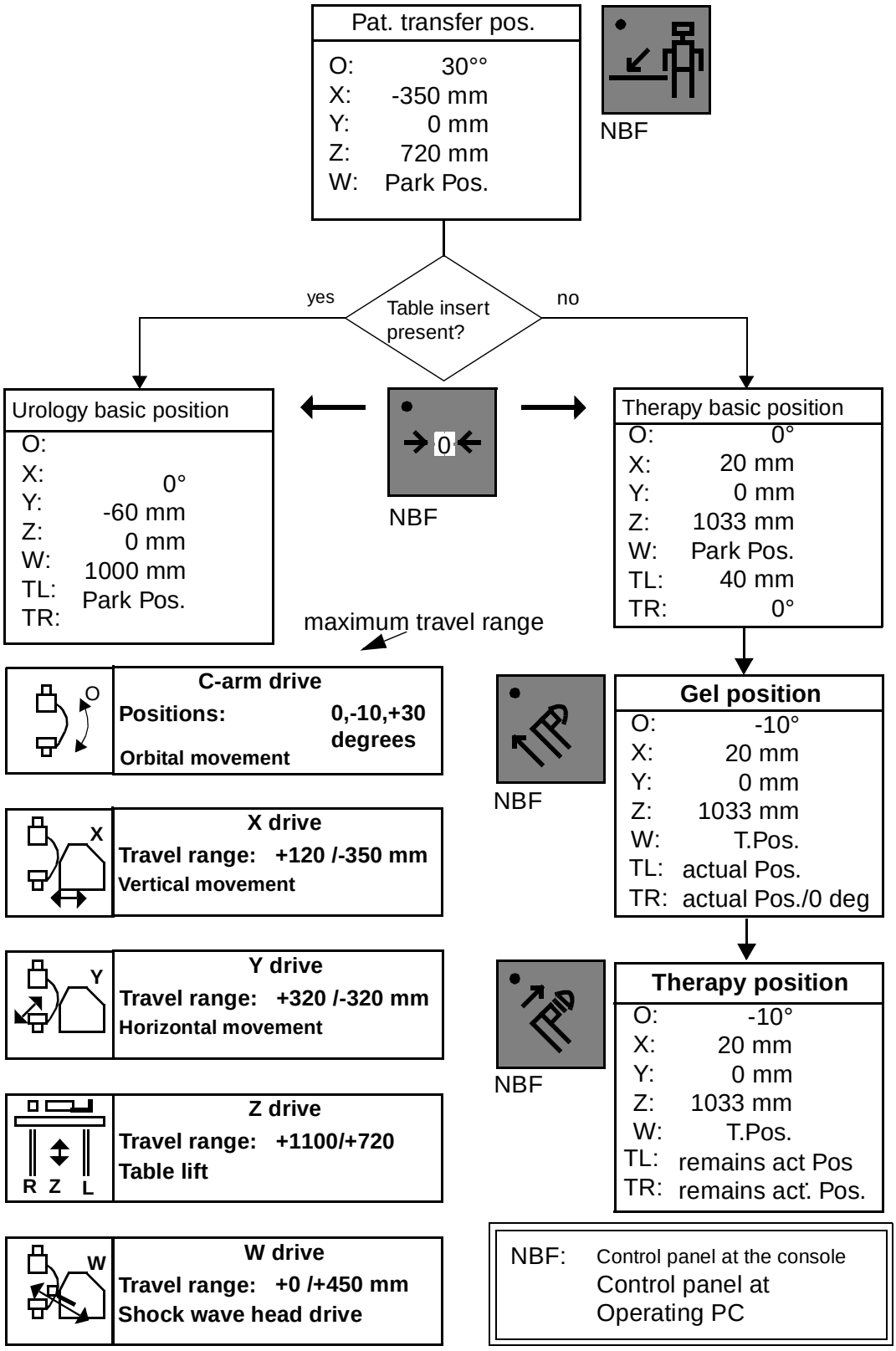
  X = -60 Travel range +70mm / -130mm
  Y = 0 Travel range +/- 320mm

**Basic position indicators for Therapy mode**

- Working table height for Therapy mode (Z=1033mm)
  (Travel range 970 -1070)
- C-arm 0° (Travel range +30 / -10°)
- Shock wave head in park position

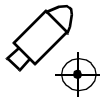
* optional

**Operating monitor displays for the most important system positions**




*TL/TR: refer to the chapter: Ultrasound function unit*

*Gel position*



Shock head in the Isocenter

Gel position attained

In this position, the user has free access to the shock wave head. The patient table is moved all the way up. Coupling gel can be comfortably applied.

**Gel position indicator (refer also to operating monitor)**

- Shock wave head in the therapy position (Isocenter)
- C-arm positioned at -10°
- X=120mm, Y = localization position, Z = 1116 mm

All drives are blocked in this position; if a key is activated on the control panel, an audible signal is heard.

*Therapy position*

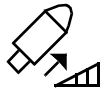
Therapy position can be reached only via the gel position.

The table is lowered from the gel position with the patient at the coupling bellows. At the same time, the C-arm carrier moves back (X direction). The stone is then moved into the central beam of the X-ray system and is directed toward the isocenter.

**Indicators of the therapy position (refer to the operating monitor)**

Shock head in the Isocenter

Coupling pressure not attained



Coupling pressure attained

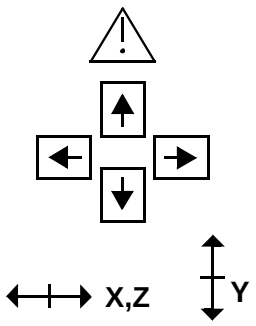
- Shock wave head in the therapy position (Isocenter)
- C-arm positioned at -10°
- X, Y, Z
  The movement of drives X, Y and Z depends upon the position of the C-arm, the pre-localization position when leaving the shock wave head park position and movement into the gel position.
- The coupling pressure display on the operating monitor can indicate one of two conditions:
  Coupling pressure attained or coupling pressure not attained.
  (refer to the fig. on the left)

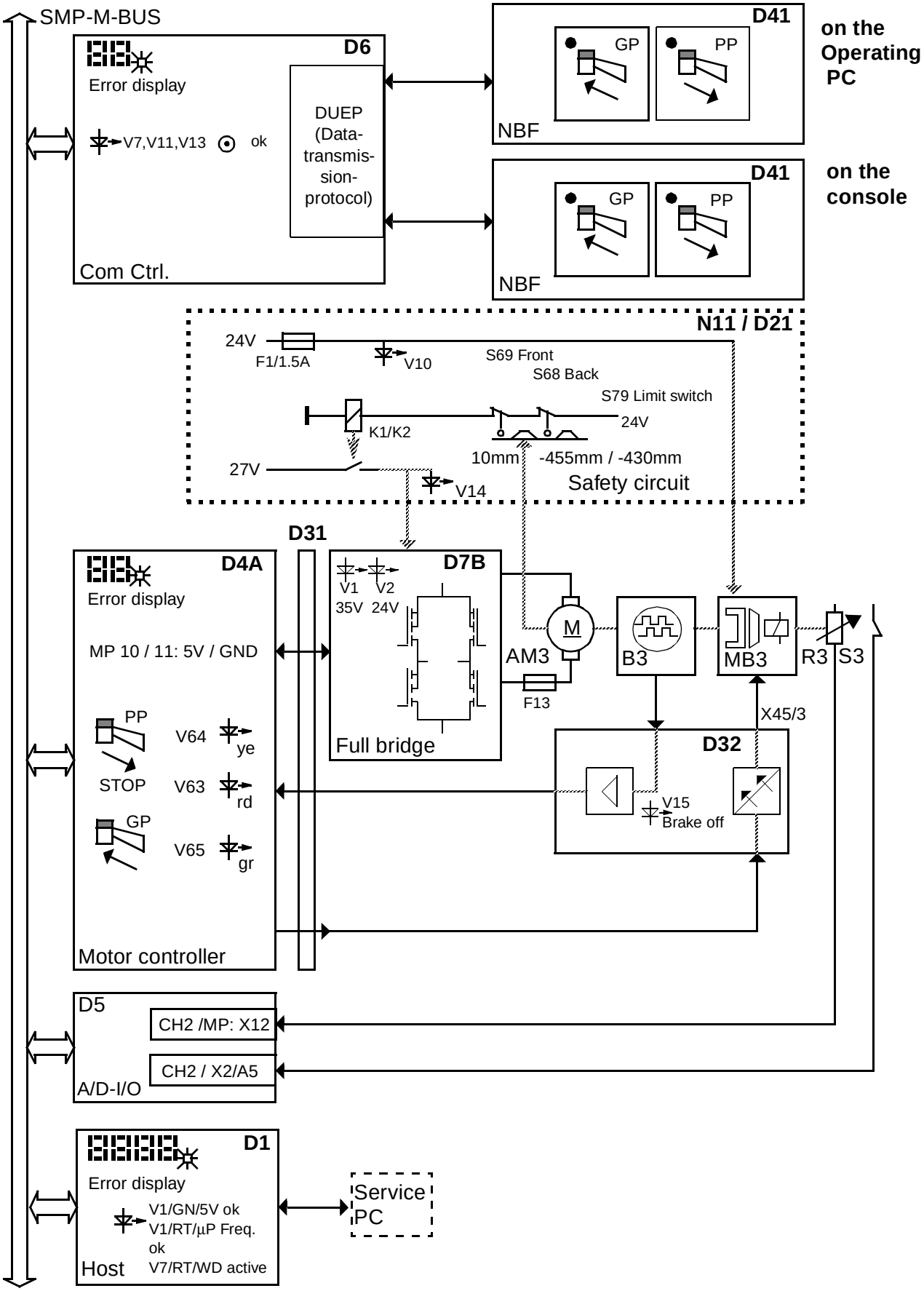
**Travel ranges in therapy position (HBF, NBF,GFS)**

| | |
|---|---|
| C-arm: | -10, 0, 30° |
| X-direction: | 40 mm to -25 mm |
| Y-direction: | 25 mm to -25 mm |
| Z-direction: | 970 mm to 1070 mm |

*Fine positioning*

The characters to the left appear on the operating monitor after selecting fine positioning. The X,Y,Z displays disappear. The arrow keys of the PC keyboard move the kidney stone in the indicated direction (relative to the FL monitor).




SMP-M-BUS
D6
Error display
V7,V11,V13
ok
DUEP (Data-transmis-sion-protocol)
Com Ctrl.
D41
GP
PP
NBF
on the Operating PC
D41
GP
PP
NBF
on the console
N11 / D21
24V
F1/1.5A
V10
S69 Front
S68 Back
S79 Limit switch
24V
K1/K2
27V
10mm
-455mm / -430mm
V14
Safety circuit
D31
D4A
Error display
MP 10 / 11: 5V / GND
PP
STOP
GP
V64
ye
V63
rd
V65
gr
Motor controller
D7B
V1
V2
35V
24V
Full bridge
M
AM3
F13
B3
MB3
R3
S3
X45/3
D32
V15
Brake off
D5
CH2 /MP: X12
CH2 / X2/A5
A/D-I/O
D1
Error display
V1/GN/5V ok
V1/RT/µP Freq. ok
V7/RT/WD active
Host
Service PC

## Shock wave drive “W”

We can use the shock wave drive as an example for all the drives, Precisely put, it cannot be moved by itself, rather it moves in relation to the X,Y and Z drives.

The shock wave head moves in the direction of the therapy position when the "GP=gel position" key is pressed on the control panel. On the other hand, it moves into the park position when the "PP=park position" key is pressed.

The movement command is transmitted via the serial interface to Com control D6.

If LED’s V7, V11 and V13 are lit up, data transmission is normal.

Com Control indicates 55 (or 60 without an ultrasound unit connected) and a flashing decimal point; this is not an error. For programming reasons, the display cannot be set to 00 if no error is present.

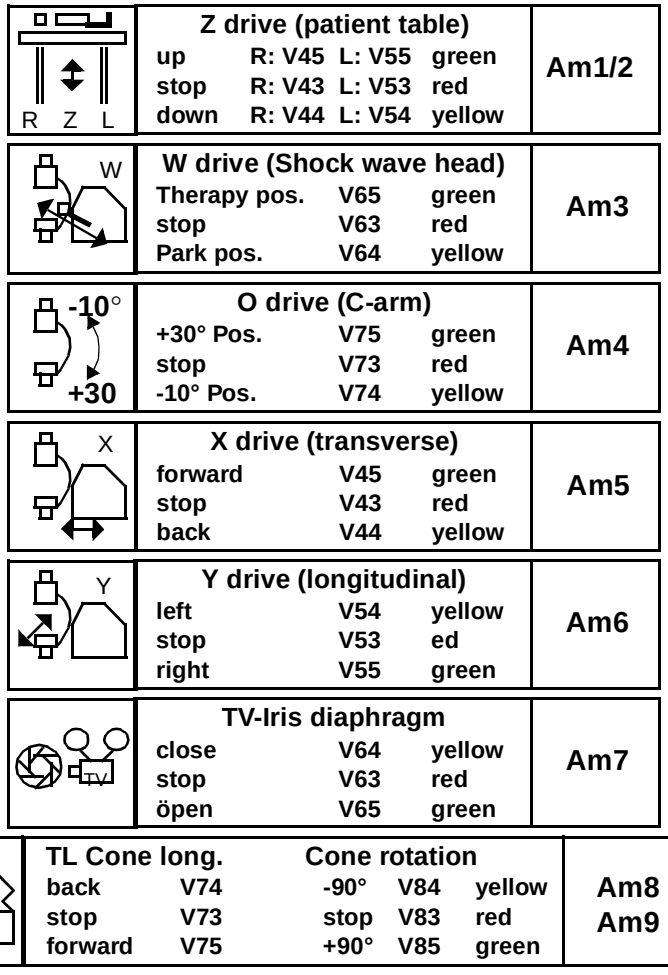
Similarly, the HOST and the motor controller boards indicate 00 with a flashing decimal point, however, this does not indicate an error.

The rest of the displays of the motor controller depend upon the starting positions of the drives.

There are three displays for each drive:

*Motor controller D4a*

*Motor controller D4b*




| | | | | |
|---|---|---|---|---|
| **Z drive (patient table)** | | | | **Am1/2** |
| **up** | **R: V45** | **L: V55** | **green** | |
| **stop** | **R: V43** | **L: V53** | **red** | |
| **down** | **R: V44** | **L: V54** | **yellow** | |
| **W drive (Shock wave head)** | | | | **Am3** |
| **Therapy pos.** | **V65** | | **green** | |
| **stop** | **V63** | | **red** | |
| **Park pos.** | **V64** | | **yellow** | |
| **O drive (C-arm)** | | | | **Am4** |
| **+30° Pos.** | **V75** | | **green** | |
| **stop** | **V73** | | **red** | |
| **-10° Pos.** | **V74** | | **yellow** | |
| **X drive (transverse)** | | | | **Am5** |
| **forward** | **V45** | | **green** | |
| **stop** | **V43** | | **red** | |
| **back** | **V44** | | **yellow** | |
| **Y drive (longitudinal)** | | | | **Am6** |
| **left** | **V54** | | **yellow** | |
| **stop** | **V53** | | **ed** | |
| **right** | **V55** | | **green** | |
| **TV-Iris diaphragm** | | | | **Am7** |
| **close** | **V64** | | **yellow** | |
| **stop** | **V63** | | **red** | |
| **öpen** | **V65** | | **green** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **TL Cone long.** | | **Cone rotation** | | | **Am8** | |
| **back** | **V74** | **-90°** | **V84** | **yellow** | **Am9** | |
| **stop** | **V73** | **stop** | **V83** | **red** | | |
| **forward** | **V75** | **+90°** | **V85** | **green** | | |

## Overview of the drives - Tables

### Overview of the motors

| Drive | | Motor | Poti | Ref.- Switch | Incr.- Trans. | Mag.-brakes |
|---|---|---|---|---|---|---|
| Table lift, right | ZR | am 1 | R1 | S1 | B1 | |
| Table lift, left | ZL | am 2 | R2 | S2 | B2 | |
| Shock head drive | W | am 3 | R3 | S3 | B3 | MB3 |
| System orbital | O | am 4 | R4 | S4 | B4 | MB4 |
| System transverse | X | am 5 | R5 | S5 | B5 | MB5 |
| System longitudinal | Y | am 6 | R6 | S6 | B6 | MB6 |
| TV Iris | | am 7 | R7 | - | B7 | |
| Cone longitudinal | TL | am 8 | R8 | S8 | B8 | |
| Cone Rotation (optional) | TR | am 9 | R9 | S9 | B9 | |

### Safety limit switches for the smaller drives

| | | |
|---|---|---|
| S40 | N.C. | Cone longitudinal movement in the range of 61.5 --> 63 mm |
| S41 | N.C. | Cone longitudinal movement in the range of -1.5 --> -3 mm |
| S42 | N.C. | Cone rotation in the range of +96 --> +103° and -96 --> -103° |

### Safety limit switches for the larger drives

| | | |
|---|---|---|
| S60 | N.C. | right lifting column ZR retracted |
| S61 | N.C. | ZR extended |
| S62 | N.C. | left lifting column ZL retracted |
| S63 | N.C. | ZL extended |
| S64 | N.C. | Y left |
| S65 | N.C. | Y right |
| S66 | N.C. | X back |
| S67 | N.C. | X forward |
| S68 | N.C. | Shock wave head park position (W-drive) |
| S69 | N.C. | Shock wave head therapy position |
| S70 | N.C. | O -10° (C-arm) |
| S71 | N.C. | O +30° |
| S76 | N.C. | X-limit left restricted travel range |
| S77 | N.C. | X-limit right restricted travel range |
| S78 | N.C. | X-limit restricted travel range |
| S79 | N.O. | Recognition switch for Therapy mode |

*End stages D7x*

The LEDs indicate: ”Operating voltage present”.

With reference to the detailed example of the shock wave head drive (W drive), the table on page 5-12 should suffice for all other drives.

*D4x , D7x*

The control boards are identical; they have different names because of the different drives they control.
Information pertaining to reference switches, incremental transmitters or brakes with respect to the drives is located in the tables on page 5-12 .

Boards D4a/b have different addresses which can be set; otherwise they are identical.

Boards D7A... are interchangeable. However, a PIN address is required.

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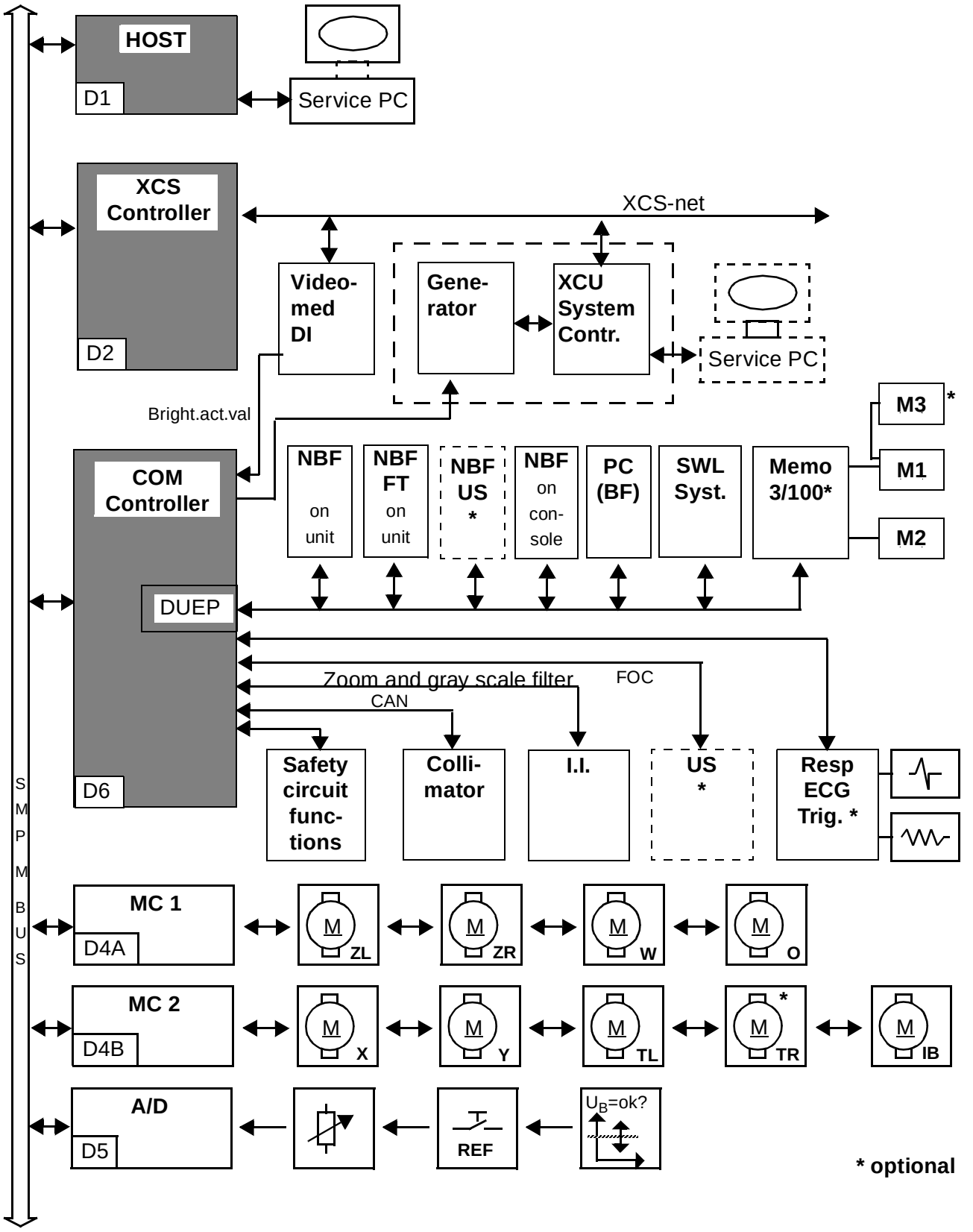
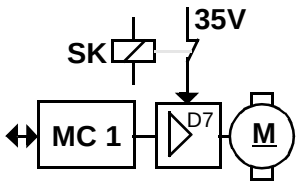

HOST
D1
Service PC
XCS Controller
D2
XCS-net
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
COM Controller
NBF on unit
NBF FT on unit
NBF US *
NBF on con-sole
PC (BF)
SWL Syst.
Memo 3/100*
M3 *
M1
M2
DUEP
Zoom and gray scale filter
FOC
CAN
D6
Safety circuit func-tions
Colli-mator
I.I.
US *
Resp ECG Trig. *
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M TR *
M IB
A/D
D5
REF
UB=ok?
* optional

## Safety circuit for larger drives

*FUNCTION*

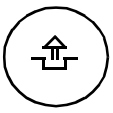



All drives have been provided with **limit switches** at the end of their respective travel ranges. If the drive exceeds the end position established by the software (system malfunction), the limit switch closes and interrupts the safety circuit (**SK**). Result: the operating voltages for the motor end stages (D7A...D7F) are switched off immediately and the HOST transitions to safety mode.
An error message is transmitted. The drive cannot be moved from this position (moved in the opposite direction) unless service switches S58, S59 are activated.

*Large drives*

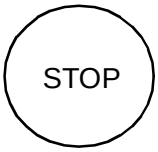
| Large drives | | |
|---|---|---|
| ZR: | Lifting column, right | AM1 |
| ZL: | Lifting column, left | AM2 |
| W: | Shock wave head | AM3 |
| O: | Orbital (C-arm) | AM4 |
| X: | System transverse | AM5 |
| Y: | System longitudinal | AM6 |

*Collision protection*

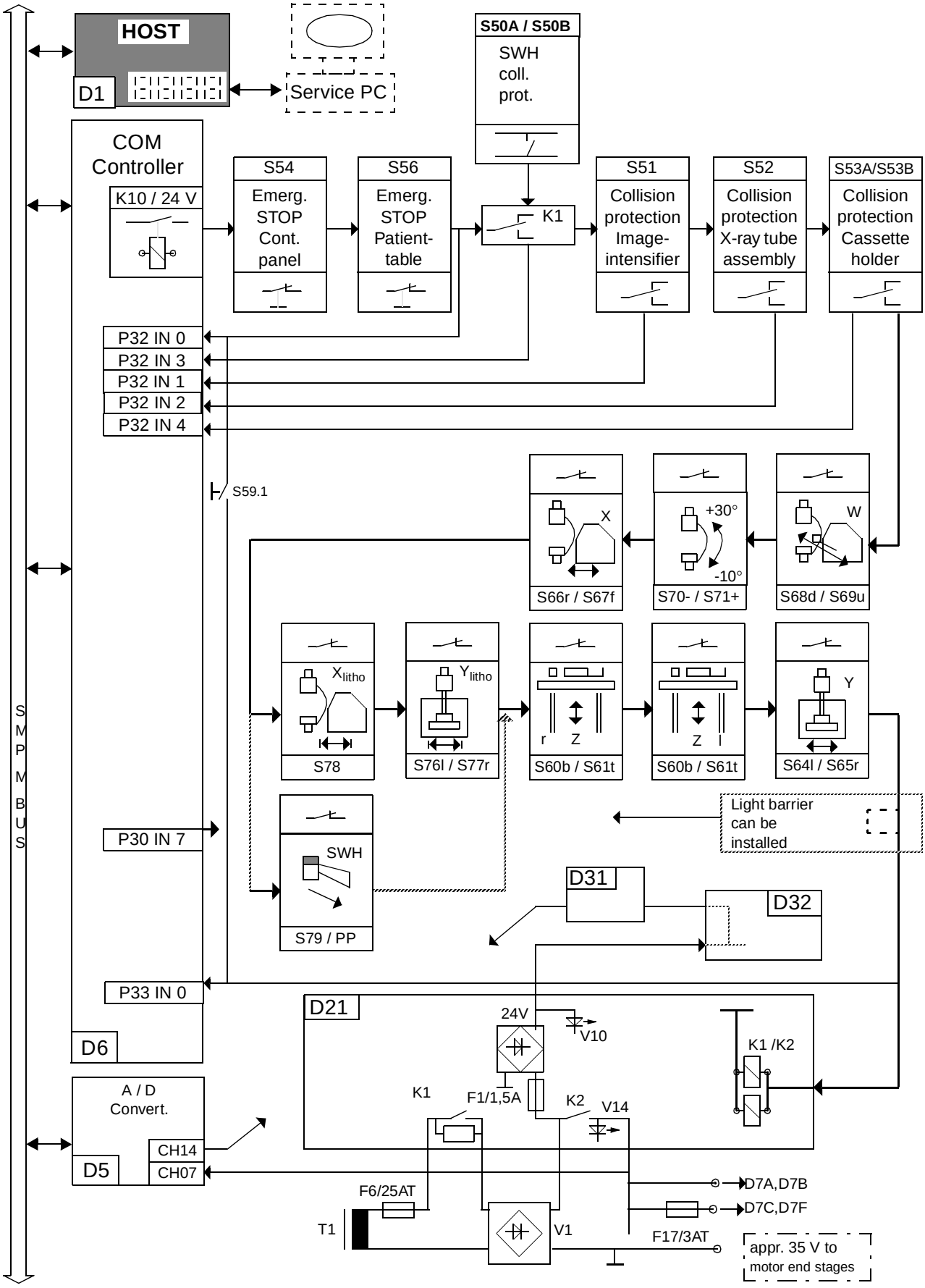


As a rule, danger of patient injury can be minimized by maintaining the required safety distances. At locations where this is not possible (at the I.I., shock wave head, X-ray tube and cassette holder), additional collision protection switches have been provided.
The safety circuit is interrupted when a collision protection switch is activated. However, by activating a safety switch (at the patient table) the system can be moved out of this position in the opposite direction. While the system moves in the opposite direction, an audible signal sounds. If the system travels further into the direction of a collision, the signal changes to a higher frequency.

*EMERGENCY STOP*




One emergency stop button is located on the patient table and a second is on the PC control desk.
When the emergency stop button is pressed, the voltage supplied to the drives is interrupted. All motorized movements, radiation and shock wave release are immediately stopped. The Host transmits an error message.


HOST
D1
Service PC
S50A / S50B
SWH
coll.
prot.
COM
Controller
K10 / 24 V
S54
Emerg.
STOP
Cont.
panel
S56
Emerg.
STOP
Patient-
table
K1
S51
Collision
protection
Image-
intensifier
S52
Collision
protection
X-ray tube
assembly
S53A/S53B
Collision
protection
Cassette
holder
P32 IN 0
P32 IN 3
P32 IN 1
P32 IN 2
P32 IN 4
S59.1
X
+30°
-10°
W
S66r / S67f
S70- / S71+
S68d / S69u
X litho
Y litho
Y
r
Z
Z
l
S78
S76l / S77r
S60b / S61t
S60b / S61t
S64l / S65r
Light barrier
can be
installed
P30 IN 7
SWH
S79 / PP
D31
D32
P33 IN 0
D21
24V
V10
K1 /K2
K1
F1/1,5A
K2
V14
D6
A / D
Convert.
CH14
CH07
D5
F6/25AT
T1
V1
D7A,D7B
D7C,D7F
F17/3AT
appr. 35 V to
motor end stages
SMPMBUS

*Function*

The HOST controls and monitors the **safety circuit (SK)** for the large drives with the assistance of the COM-Controller. If the safety circuit is open, i.e. a safety switch is activated, the Host transmits an error message that refers to the type of interruption e.g. Emergency Stop activated or safety switch responded (refer to the error list).

*Feedback signals COM Controller A/D Converter*

The HOST receives information on the status of the safety circuit from the COM controller via the input ports (e.g. P32 IN 0).
The HOST can verify whether the voltage values are correct via the A/D converter.

*Switch-on phase*

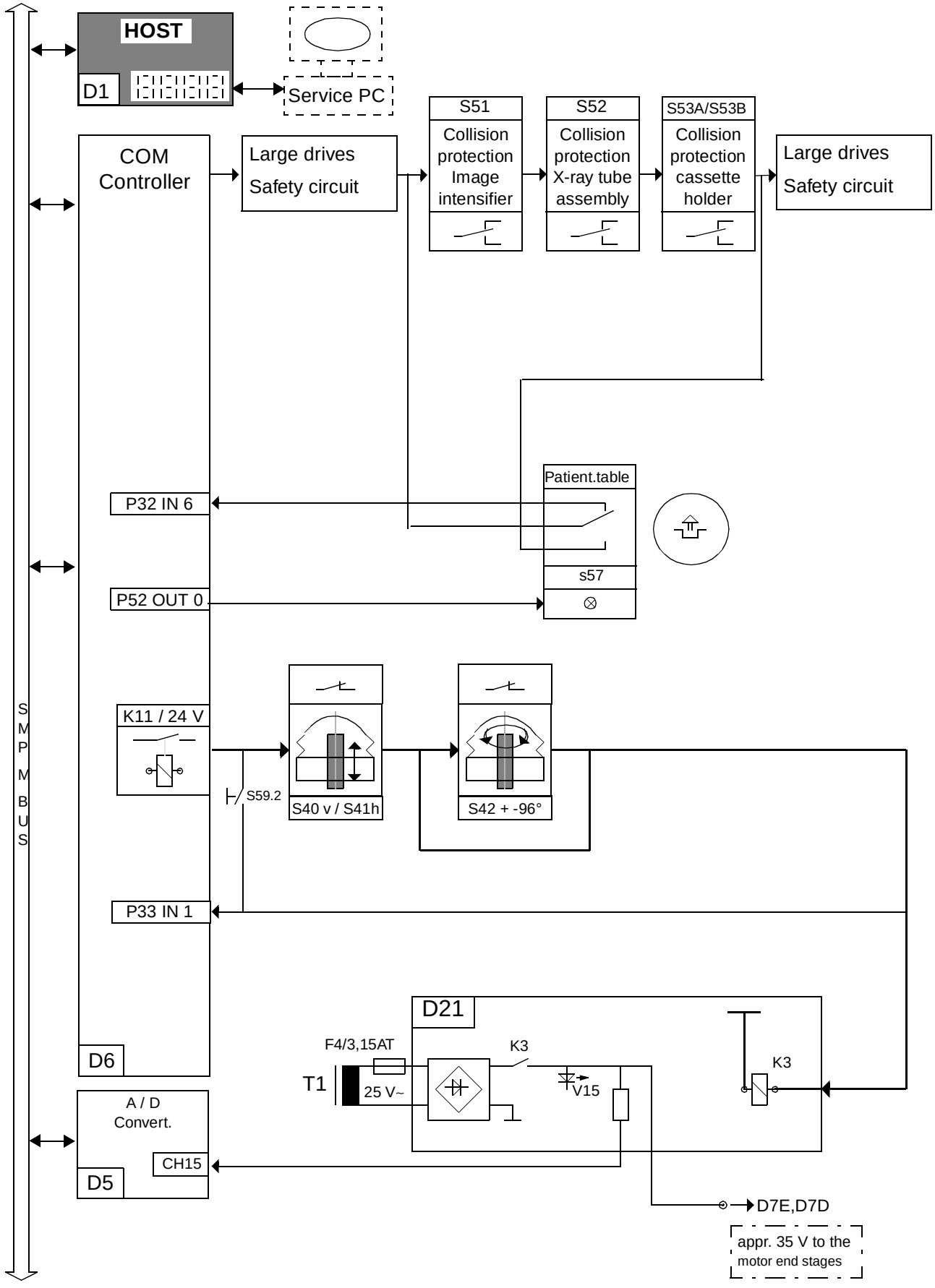
*Contacts K1, K2 V14, V10*

1) K10/24V switch on.
   Provided that all safety switches are in the normal position, relays K1 and K2 switch on.
   The relay contacts of K1,K2 transmit the operating voltages to the motor end stages D7A, etc.... and V14 and V10 light up. The HOST receives the feedback signal via channel 7 of the A/D converter and P33IN0. **Relay contacts switched on**.
2) K10/24V switch off.
   The HOST switches off the operating voltages to the motor end stages. Via the feedback channels (refer to the above), the HOST verifies whether the **Relay contacts are frozen**.
3) K10/24V switch on.
   This is the last step in the switch-on phase. After switching on the operating voltage for the motor end stages and running the subsequent test, the system transitions to Standby mode once initialization is complete.

| NOTICE | **If the contacts freeze or do not switch off, the Host will recognize this error and will transmit an error message.** |
|---|---|

*Normal mode*

If the safety circuit is interrupted while in normal mode, it is important to distinguish between the following conditions:


HOST
D1
Service PC
S51
Collision protection Image intensifier
S52
Collision protection X-ray tube assembly
S53A/S53B
Collision protection cassette holder
COM Controller
Large drives Safety circuit
Large drives Safety circuit
Patient.table
s57
P32 IN 6
P52 OUT 0
K11 / 24 V
S59.2
S40 v / S41h
S42 + -96°
P33 IN 1
D21
F4/3,15AT
T1
25 V~
K3
V15
K3
D6
A / D Convert.
CH15
D5
D7E,D7D
appr. 35 V to the motor end stages
S M P M B U S

a) One of the emergency stop switches has responded. The HOST recognizes that a switch was activated and transmits a message to the operating monitor. If a collision protection switch was activated, the system can be moved using the emergency switch. (Lamp in S57 goes on, audible signal sounds.)

b) A safety limit switch has responded (e.g.S66/67). The HOST transmits an error message. Service is required.

*Collision protection*

Switches S50,S51,S52,S53A and S53B are collision protection switches. If, for example, the cassette holder should collide with the patient, S53A and S53B will respond. The safety circuit for the large motor drives will be interrupted, i.e. motor movements stop immediately.
The HOST controls the lamp in switch key S57 via P52 OUT 0. The circuit is closed again and movements will be resumed by pressing this key. Travel speed is reduced and an audible signal sounds when moving the system in the opposite direction (this signal sounds at double the frequency when moving the system in the direction of a collision).

## Safety circuit for smaller drives

*Smaller drives*

The safety circuit for the smaller drives has been designed for the purpose of protecting the **cone control** drives from mechanical damage.

*Switch-on phase*

The Host switches on the circuit via relay K11 24V. If the safety limit switches are activated, relay K3 is switched on and approximatelyz 35 V is forwarded to the motor end stages D7E, D7D. V15/D21 lights up.

*Feedback signals COM Controller A/D converter*

The feedback signals for the HOST to monitor the safety circuit are transmitted via P33IN1 and channel 15 of the A/D converter.

| Small drives | | |
|---|---|---|
| IB: | Iris diaphragm | AM7 |
| TL: | Cone longitudinal | AM8 |
| TR: | Cone rotation * | AM9 |

* optional

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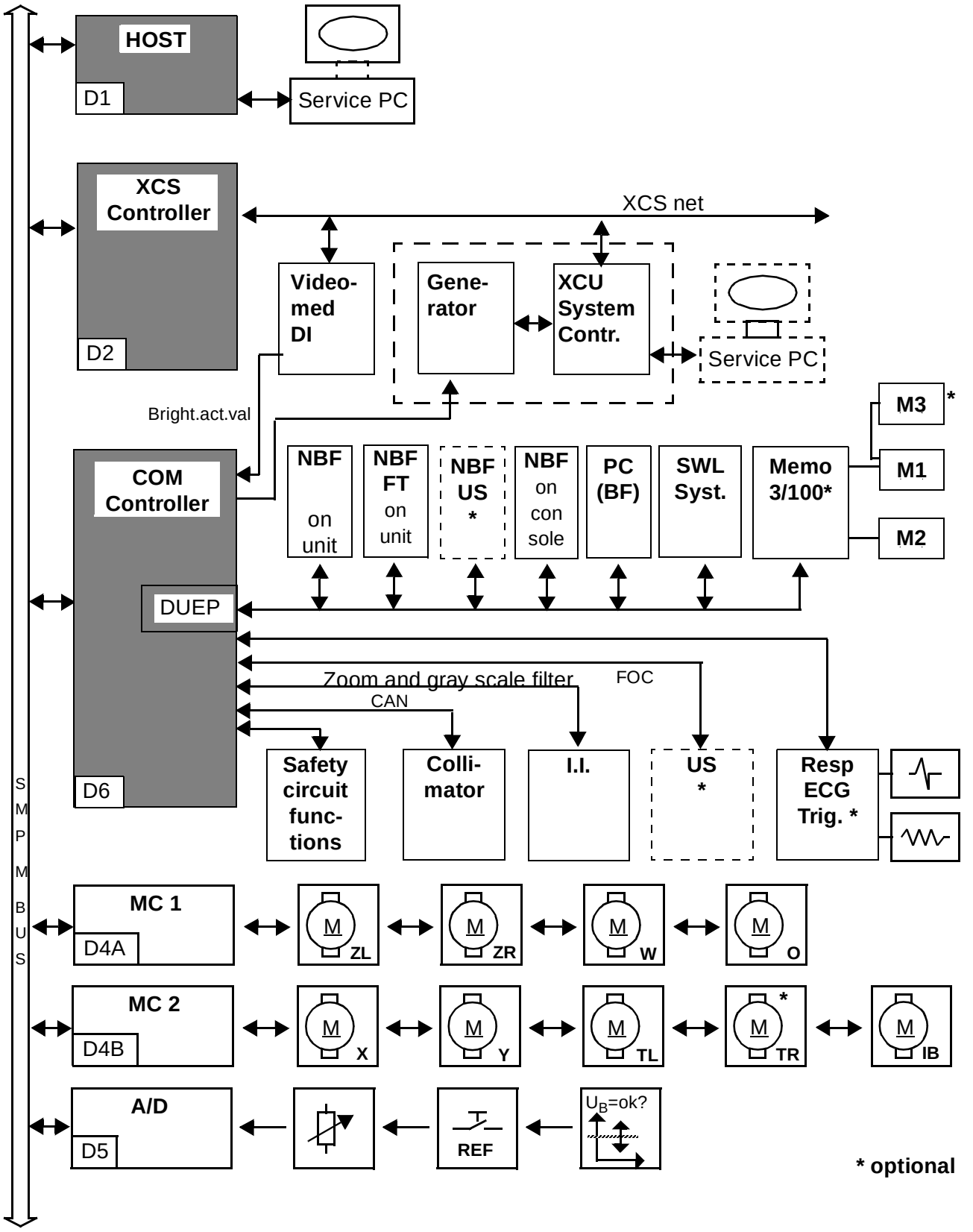

HOST
D1
Service PC
XCS Controller
D2
XCS net
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
COM Controller
NBF on unit
NBF FT on unit
NBF US *
NBF on con sole
PC (BF)
SWL Syst.
Memo 3/100*
M3 *
M1
M2
DUEP
Zoom and gray scale filter
FOC
CAN
D6
Safety circuit func-tions
Colli-mator
I.I.
US *
Resp ECG Trig. *
S M P M B U S
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M * TR
M IB
A/D
D5
REF
UB=ok?
* optional

## Interfaces N11 / N12

Data transfer between the shock wave system (W16) and Host (D1) occurs via one of the serial DUEP interfaces of the COM controller (D6).
The interface controller in the shock wave system is located at W16. Via D6, the shock wave system receives or sends information such as:

**Energy level status**

**Shock wave frequency and release**

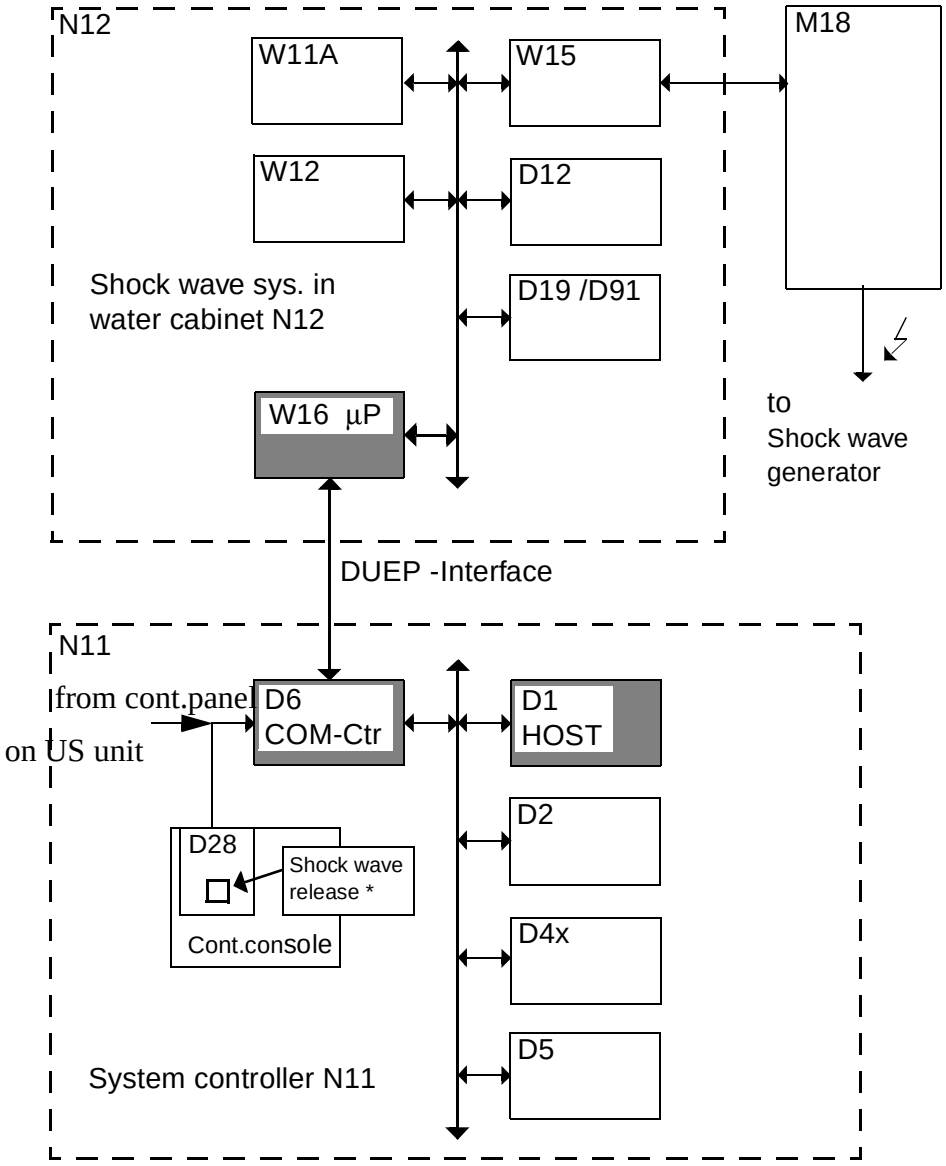
**Release of shock waves**

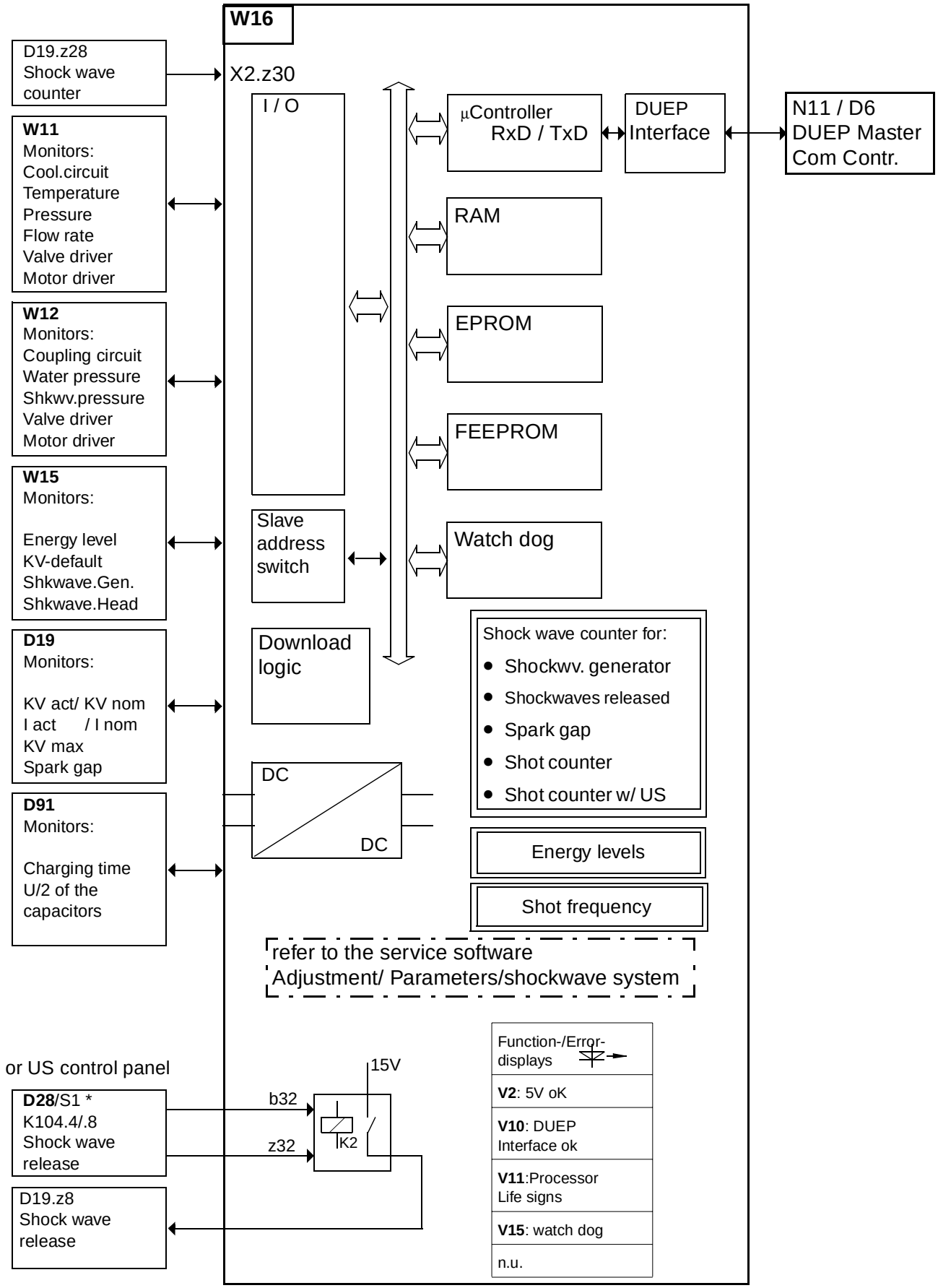
**ECG- respiratory trigger selection**

**Resetting shot counter, shot counter value**

**Error status**

**Coupling pressure nominal value, water flow, etc.**




W16
D19.z28
Shock wave
counter
X2.z30
I / O
µController
RxD / TxD
DUEP
Interface
N11 / D6
DUEP Master
Com Contr.
W11
Monitors:
Cool.circuit
Temperature
Pressure
Flow rate
Valve driver
Motor driver
RAM
W12
Monitors:
Coupling circuit
Water pressure
Shkwv.pressure
Valve driver
Motor driver
EPROM
FEEPROM
W15
Monitors:
Energy level
KV-default
Shkwave.Gen.
Shkwave.Head
Slave
address
switch
Watch dog
D19
Monitors:
KV act/ KV nom
I act / I nom
KV max
Spark gap
Download
logic
Shock wave counter for:
Shockwv. generator
Shockwaves released
Spark gap
Shot counter
Shot counter w/ US
D91
Monitors:
Charging time
U/2 of the
capacitors
DC
DC
Energy levels
Shot frequency
refer to the service software
Adjustment/ Parameters/shockwave system
Function-/Error-
displays
V2: 5V oK
V10: DUEP
Interface ok
V11:Processor
Life signs
V15: watch dog
n.u.
or US control panel
D28/S1 *
K104.4/.8
Shock wave
release
b32
z32
15V
K2
D19.z8
Shock wave
release

## Interface board W16

*Tasks*

- Data reception and data preparation of and for the Com Controller D6
- Cooling circuit monitoring and regulation (W11)
- Coupling circuit monitoring and regulation (W12)
- Nominal value default for the charging unit M18 (W15)
- Monitoring shock wave release (D19,D91)

*Shock wave counter*

The processor on board W16 counts the shock waves released and transmits the counter status to the HOST.
After 500 shock waves, the processor stops shock wave release to remind the operator to check the focus.
When a new patient is entered, the counter is reset to zero via a command from the Host.

*Energy levels*

The energy level default on the operating monitor is fed back to the HOST for safety reasons and is also displayed on the monitor screen.

*Shock wave release frequency*

Maximum frequency default (established via service PC, currently 2Hz). Monitoring is handled via the W15. The actual shock wave frequency depends upon the release mode selected (ECG / respiratory triggering or free running).

*Shock wave release*

Only when all the conditions for shock wave release have been satisfied can shock waves actually be released.
This means:

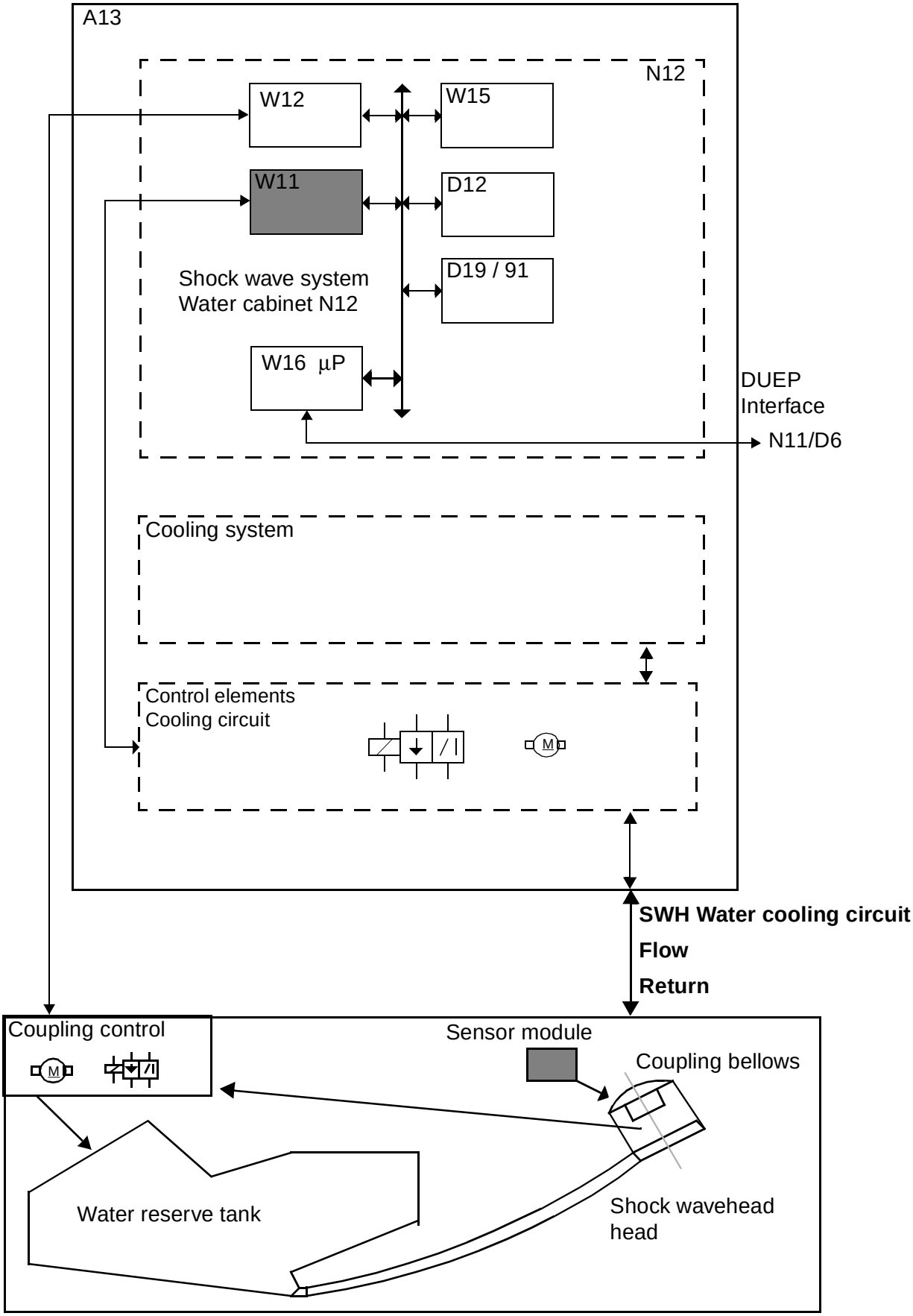
- There cannot be any overtemperature condition, flow interruption or water pressure abnormality present in the cooling circuit. The shock wave head must be located in the therapy position and the coupling pressure must be correct.
- No errors can be present in either the shock wave generator or the charging unit.
- The cone longitudinal drive must be positioned correctly.

*Shock wave release or service*

If switch **S3/W12** is set in position 2, shock wave release is possible in the therapy position without coupling pressure.

**CAUTION**

**<u>Do not release</u> shock waves If the isocenter measurement phantom is installed on the shock wave head. This may cause damage.**


A13
N12
W12
W15
W11
D12
D19 / 91
Shock wave system
Water cabinet N12
W16 µP
DUEP
Interface
N11/D6
Cooling system
Control elements
Cooling circuit
M
SWH Water cooling circuit
Flow
Return
Coupling control
M
Sensor module
Coupling bellows
Water reserve tank
Shock wavehead
head

## Coupling control

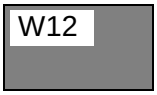
*Cooling system*

The cooling system is part of the shock wave system and is located in cabinet A13.
It consists of:

- Coupling control (W12)
- Water cooler (W11)

*Tasks of the Coupling control*

The coupling control (W12) regulates the amount of water and the water pressure in the shock wave head in the gel or therapy positions.




This results in optimal coupling of the shock wave head and initiation of the shock waves in the patient's body.
The control electronics is located in N12 on board W12.
Pneumatic control elements are located directly on the water reservoir (valves, air pumps, etc.). Board W1 (sensor module) is located on the shock wave head.

*Shock wave head*

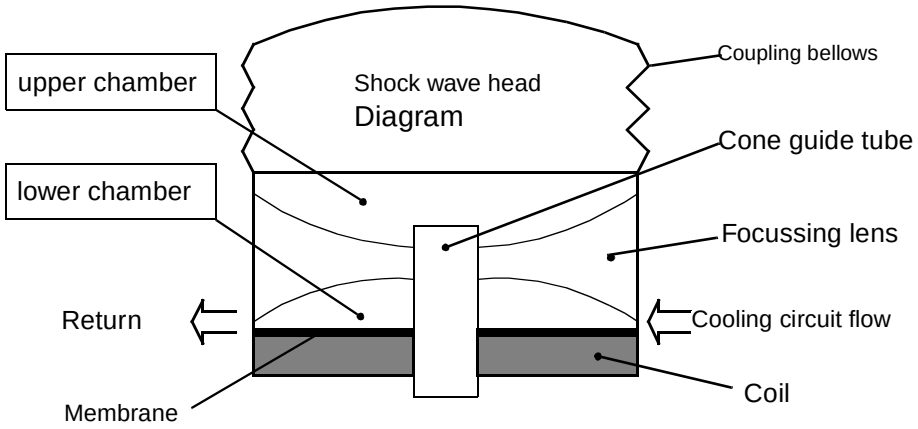
The shock wave head consists of two separate chambers filled with water. The upper chamber of the shock wave head is used for coupling to the patient (via a flexible coupling bellows). The lower chamber of the shock wave head is used for cooling the shock wave source. The static and dynamic pressure in the cooling circuit presses the membrane onto the coil of the shock wave source (important for the deflection of the membrane). The sensor module is attached to the shock wave head.

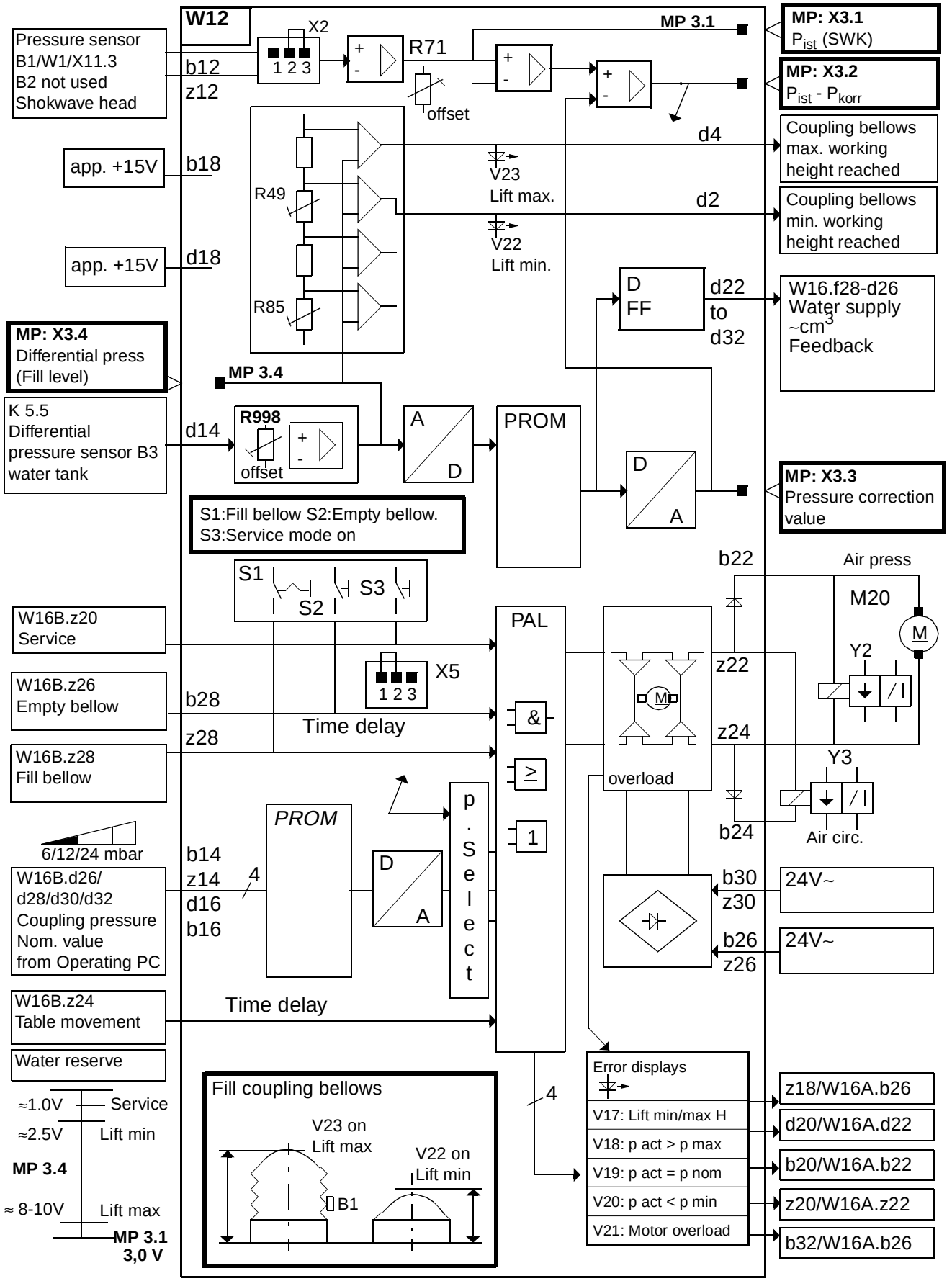
*Coupling process*

Water is pumped into the shock wave head with using air pressure (pump M1) until the correct coupling pressure is reached. At the same time, the water reservoir is monitored (fill level). If the coupling pressure becomes too high, water flows back into the water reservoir via gravity feed after a valve is opened.

The coupling pressure

- is monitored at the shock wave head by means of a pressure sensor.
- is selectable in three levels (at the operating PC).




W12
Pressure sensor B1/W1/X11.3
B2 not used
Shokwave head
b12
z12
X2
1 2 3
R71
offset
MP 3.1
MP: X3.1
Pist (SWK)
MP: X3.2
Pist - Pkorr
d4
Coupling bellows max. working height reached
app. +15V
b18
R49
V23
Lift max.
d2
Coupling bellows min. working height reached
app. +15V
d18
V22
Lift min.
R85
D
FF
d22
to
d32
W16.f28-d26
Water supply
~cm3
Feedback
MP: X3.4
Differential press (Fill level)
MP 3.4
K 5.5
Differential pressure sensor B3 water tank
d14
R998
offset
A
D
PROM
D
A
MP: X3.3
Pressure correction value
S1:Fill bellow S2:Empty bellow.
S3:Service mode on
S1
S2
S3
b22
Air press
M20
M
Y2
W16B.z20
Service
PAL
W16B.z26
Empty bellow
b28
Time delay
X5
1 2 3
z22
z24
W16B.z28
Fill bellow
z28
&
≥
1
overload
Y3
Air circ.
b24
6/12/24 mbar
PROM
p . S e l e c t
D
A
b14
z14
d16
b16
4
b30
z30
24V~
b26
z26
24V~
W16B.d26/ d28/d30/d32
Coupling pressure Nom. value from Operating PC
W16B.z24
Table movement
Time delay
Water reserve
≈1.0V
Service
≈2.5V
Lift min
MP 3.4
≈ 8-10V
Lift max
MP 3.1
3,0 V
Fill coupling bellows
V23 on
Lift max
V22 on
Lift min
B1
4
Error displays
V17: Lift min/max H
V18: p act > p max
V19: p act = p nom
V20: p act < p min
V21: Motor overload
z18/W16A.b26
d20/W16A.d22
b20/W16A.b22
z20/W16A.z22
b32/W16A.b26

*Pressure sensors B1;B2*

B1: Acquires the coupling pressure in the shock wave head and is composed of the following components:

Coupling bellows inherent expansion (depending on fill level)
Water weight in the bellows (depending on fill level)
Patient counterpressure (coupling pressure default)

X3.1: Pressure sensor actual value (approx.136mV/mbar)
(at atmospheric pressure set 1.0V ± 10mV. R71/W12)

X3.2: Pressure sensor actual value less the coupling bellow inherent expansion and water weight (Not applicable to service).

X3.3: Not applicable to service.

*Pressure sensor B3*

B3: Actual value of water pressure in water storage tank (Fill level).
Actual value pressure sensor value range approx. 1.25V - 12V.

With an empty tank and Y3 on, you measure approx. 2.5V ± 0.25V at X3.4.

*Service*

Three switches (keys) are available to activate special functions in service mode:

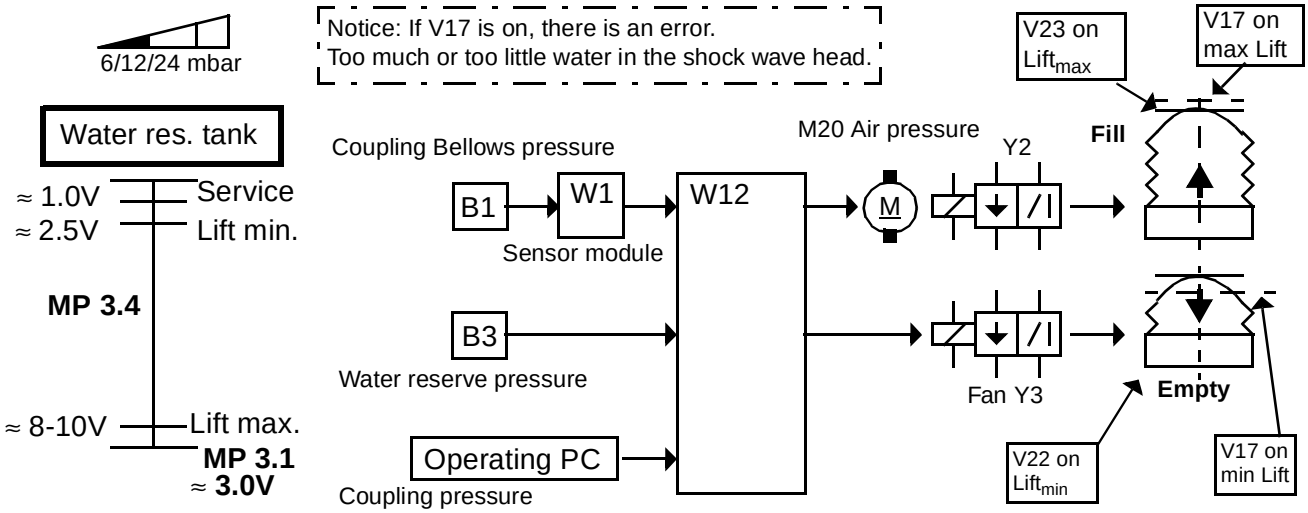
S3: If board W12 is switched on in service mode, i.e. this means switches S1 and S2 are activated and shock wave release without coupling pressure is possible.

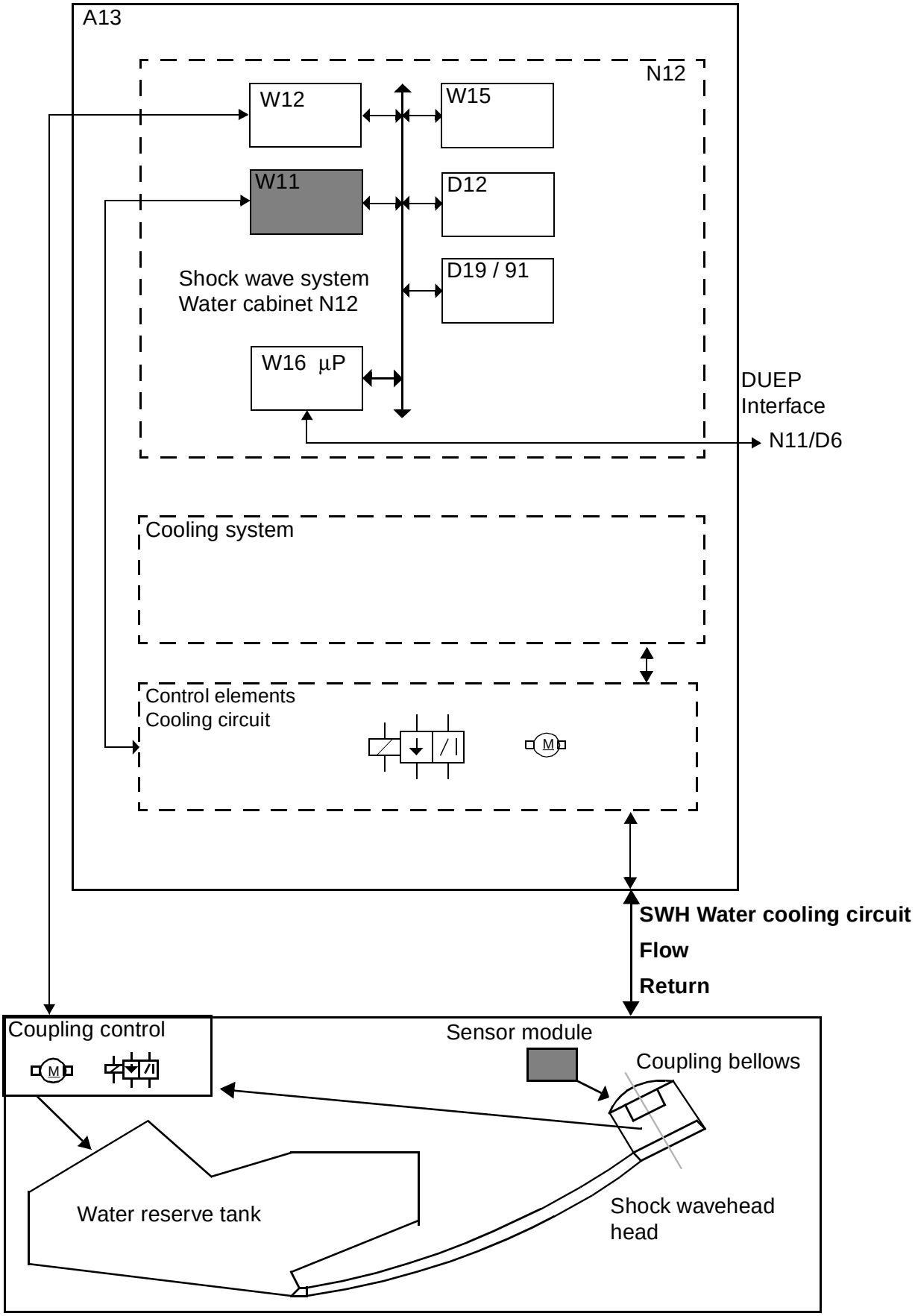
S1: (Keys)For filling the shock wave head. Switches air pump M15/Y2 on. **(Caution! The coupling bellows can burst if this switch is not shut off at the proper time.**)

S2: Empties the coupling bellows to the service level.(Y3 on)
This level is lower than for normal operation.
(For adjustments).

*Coupling pressure setting-vorgabe*

Selection available on the operating PC (Level 1, 2, or 3).



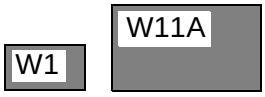

A13
N12
W12
W15
W11
D12
D19 / 91
Shock wave system
Water cabinet N12
W16 µP
DUEP
Interface
N11/D6
Cooling system
Control elements
Cooling circuit
M
SWH Water cooling circuit
Flow
Return
Coupling control
M
Sensor module
Coupling bellows
Water reserve tank
Shock wavehead
head

## Cooling system

*Tasks*

Cooling the shock wave source (SWK) and pressing the membrane against the coil.

*Water cooling circuit*



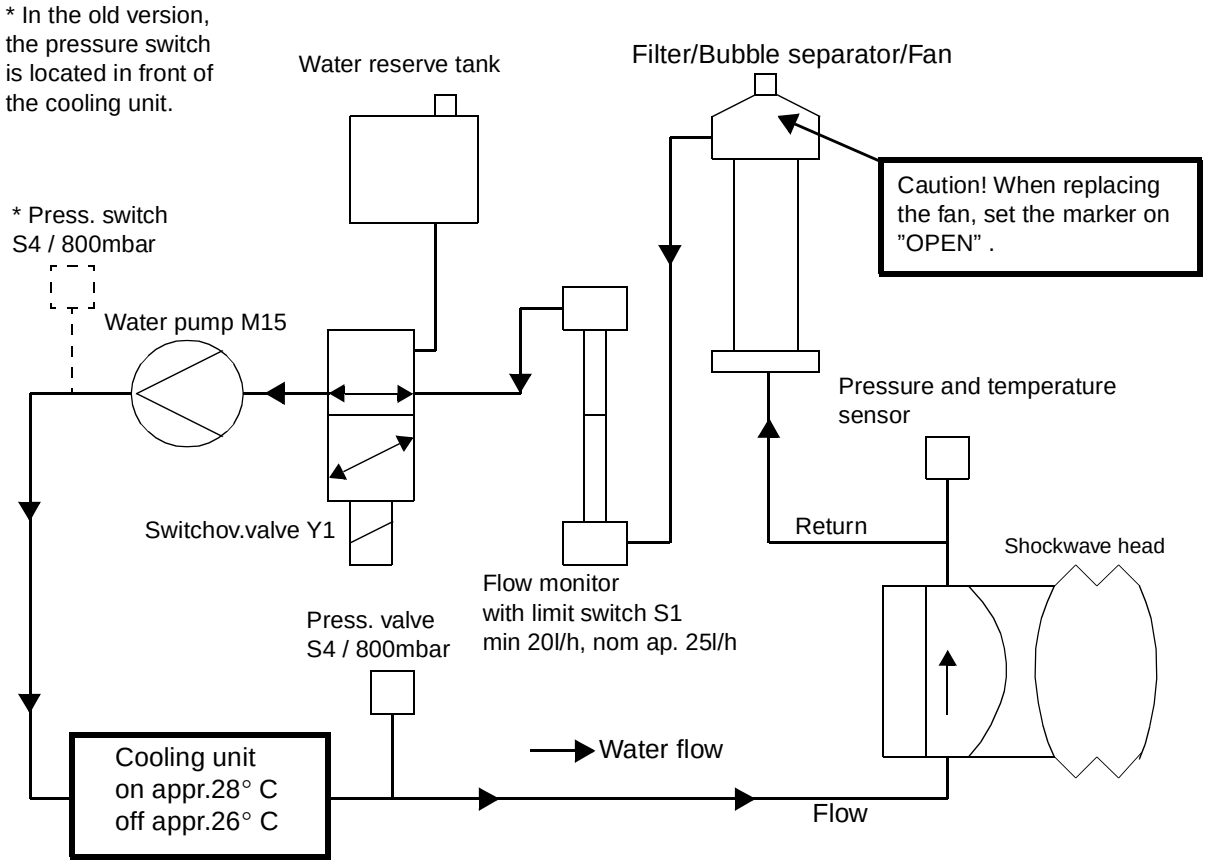

Water flows through the lower part of the shock wave head.
Water returns from the shock wave head via the filter/bubble separator, then to the flow monitor via the switchover valve to the water pump. From there, it flows back through the cooling unit to the shock wave head.

*Fill process*

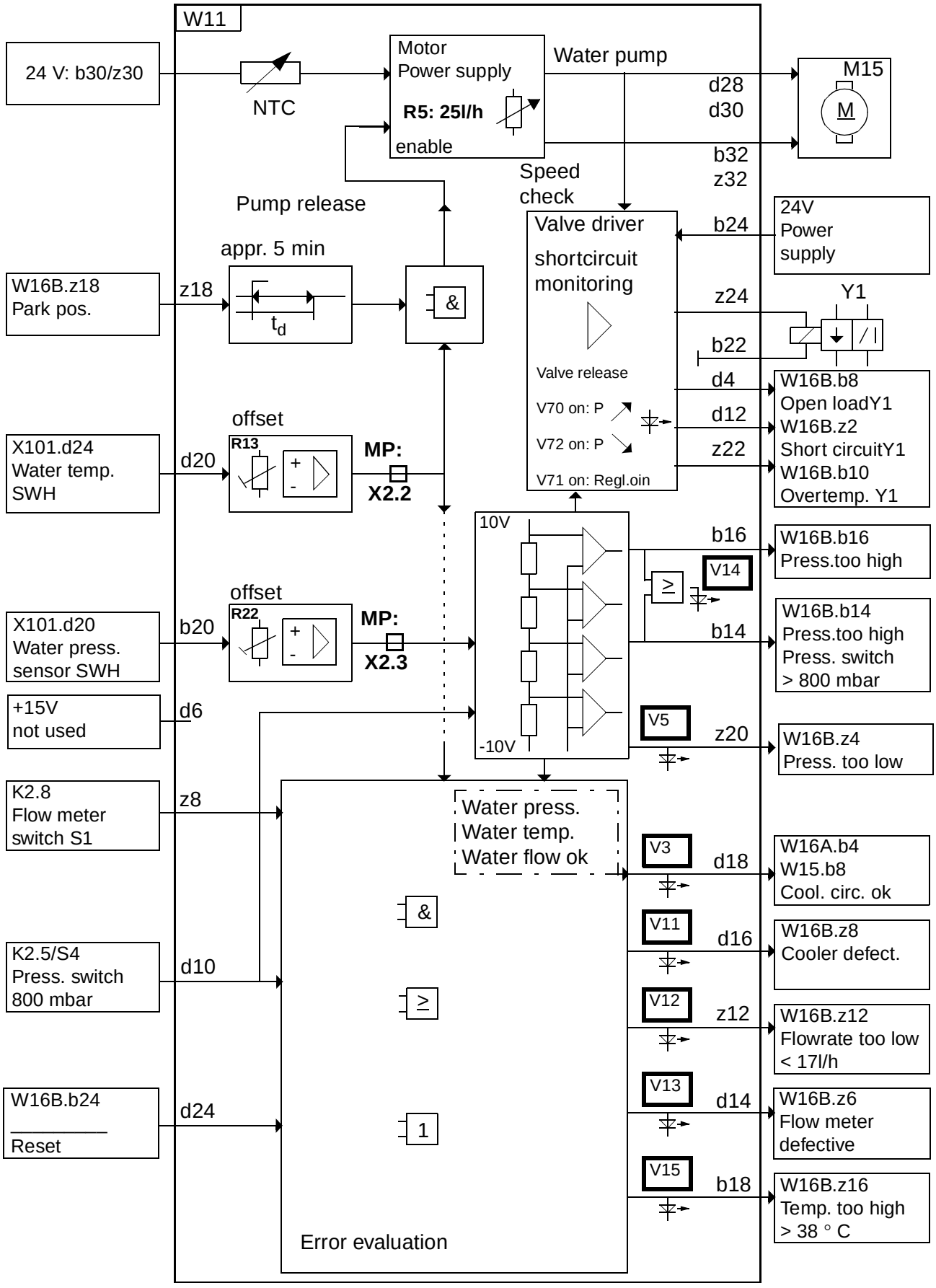
Water flows from the water reserve tank via the switchover valve to the cooling circuit.(It can also flow back into the water reserve tank.)

**NOTICE**

**The goal is to limit the water temperature in the coupling circuit to approx. 30° C, to prevent it from burning the patient's skin. The water is heated by the shock wave source during therapy mode.**


* In the old version, the pressure switch is located in front of the cooling unit.
Water reserve tank
Filter/Bubble separator/Fan
Caution! When replacing the fan, set the marker on "OPEN" .
* Press. switch S4 / 800mbar
Water pump M15
Pressure and temperature sensor
Switchov.valve Y1
Return
Shockwave head
Flow monitor with limit switch S1 min 20l/h, nom ap. 25l/h
Press. valve S4 / 800mbar
Water flow
Cooling unit on appr.28° C off appr.26° C
Flow

**Cooling circuit**


W11
24 V: b30/z30
NTC
Motor
Power supply
R5: 25l/h
enable
Water pump
d28
d30
M15
M
b32
z32
Speed
check
Pump release
appr. 5 min
W16B.z18
Park pos.
z18
td
&
Valve driver
shortcircuit
monitoring
Valve release
V70 on: P
V72 on: P
V71 on: Regl.oin
b24
24V
Power
supply
z24
Y1
b22
d4
W16B.b8
Open loadY1
W16B.z2
Short circuitY1
W16B.b10
Overtemp. Y1
d12
z22
offset
R13
X101.d24
Water temp.
SWH
d20
MP:
X2.2
10V
-10V
b16
W16B.b16
Press.too high
V14
≥
offset
R22
X101.d20
Water press.
sensor SWH
b20
MP:
X2.3
b14
W16B.b14
Press.too high
Press. switch
> 800 mbar
+15V
not used
d6
V5
z20
W16B.z4
Press. too low
K2.8
Flow meter
switch S1
z8
Water press.
Water temp.
Water flow ok
V3
d18
W16A.b4
W15.b8
Cool. circ. ok
&
V11
d16
W16B.z8
Cooler defect.
K2.5/S4
Press. switch
800 mbar
d10
≥
V12
z12
W16B.z12
Flowrate too low
< 17l/h
V13
d14
W16B.z6
Flow meter
defective
W16B.b24
Reset
d24
1
V15
b18
W16B.z16
Temp. too high
> 38 ° C
Error evaluation

## Overview of board W11

*Water pump M15*

Pumps water through the cooling circuit and should be set to approximately 25l/h with R5. This flow rate produces the measured cooling effect for the shock wave source. The shutoff rate is 20l/h.

*Water temperature*

**MP:**
□
**X2.2**

The temperature sensor monitors the water temperature directly at the shock wave head
The voltage at measurement point **X2.2** changes by approx. 200mV/ °C.

If the temperature rises above 38°C (7.6V at X2.2), shock wave release is blocked.

*SWH Park position*

When the shock wave head reaches the park position after completion of patient treatment, cooling continues for approximately 5 more minutes. Afterward (shock wave head in the park position for at least 5 minutes and water temperature at e25° C), it is switched over to partial flow (approx. 10l/h) and pressure regulation is blocked.

*Water pressure*

**MP:**
□
**X2.3**

The water pressure in the cooling circuit is also acquired directly at the shock wave head. The acceptable pressure range is between 265 mbar and 395 mbar. This means that a voltage of between 4.6V to 5.4V should be present at measurement point **X2.3** (approx. 6 mV/mbar). If the voltage value is above or below these limits the following occurs:

<u>Voltage > 5.4 V (335 - 465 mbar):</u>

Water is forced into the reserve tank to decrease the pressure.

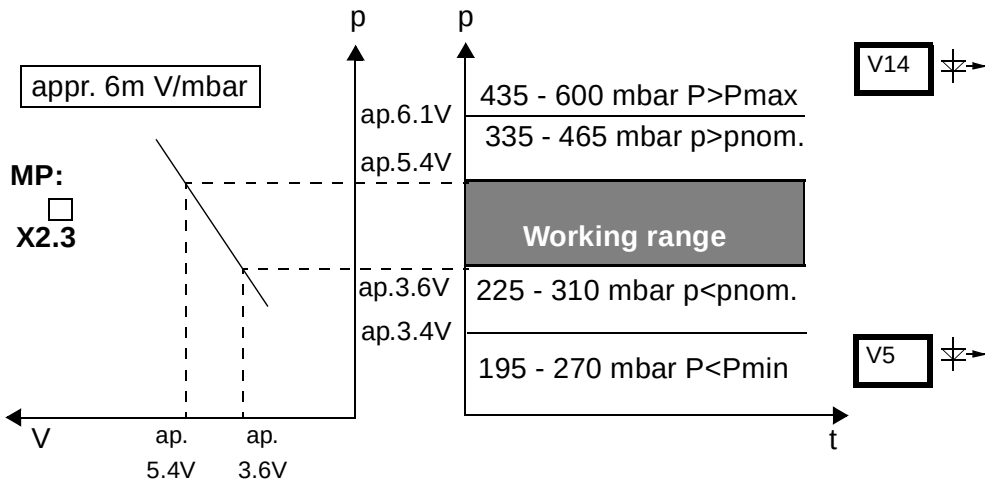
M15 is switched off and Y1 is turned on.

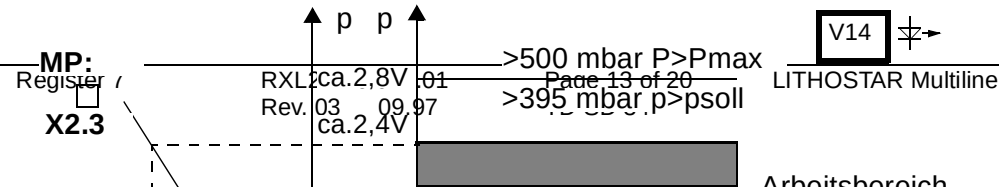
<u>Voltage < 4.6V (225 - 310 mbar):</u>

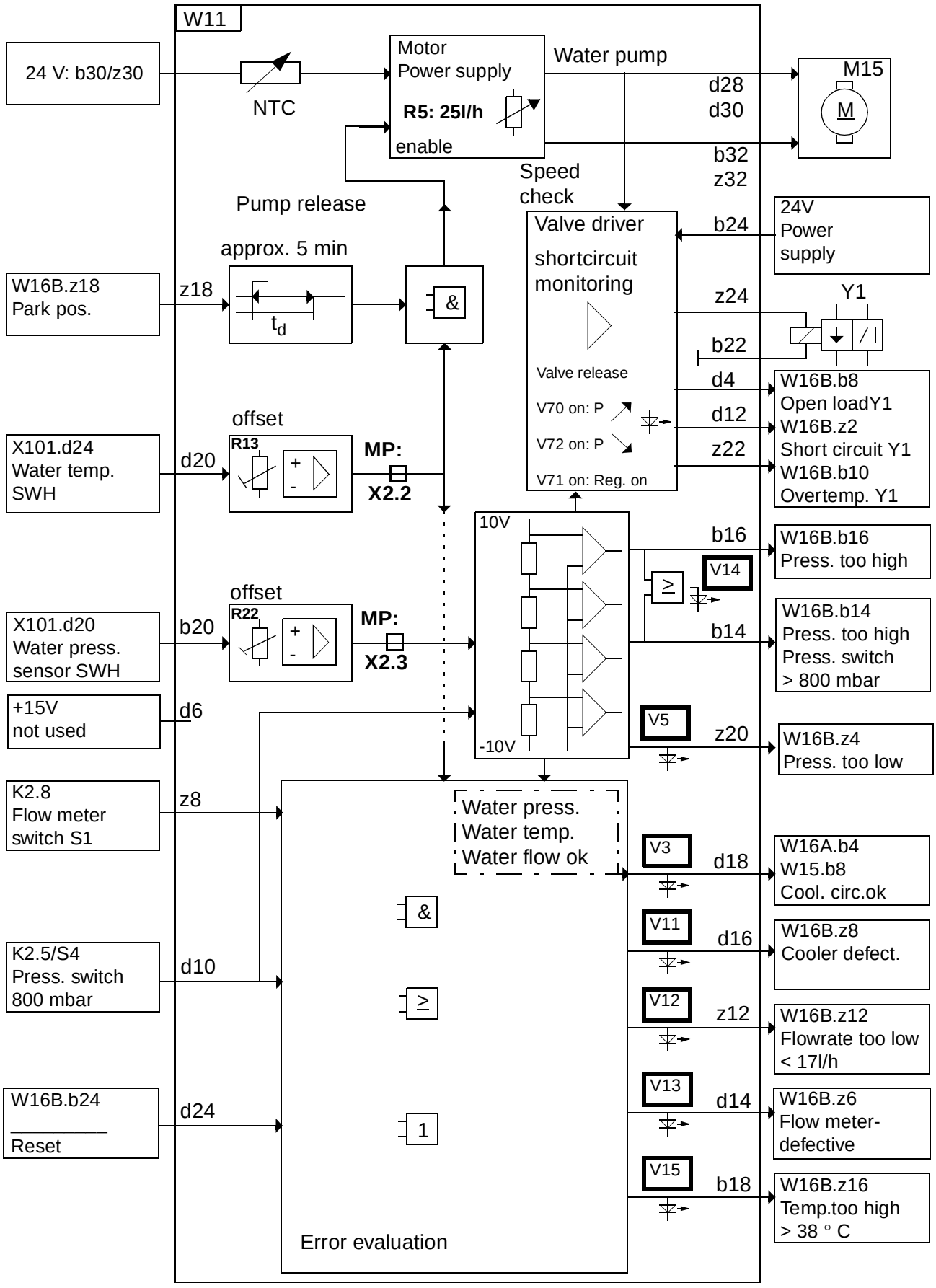
Water is forced out of the reserve tank to increase the pressure.
M15 is switched on and Y1 is turned on.

*Water pressure switch 800 mbar*

Pressure switch S4 is located in the control cabinet on the pressure side of the water pump. If it responds, the pump shuts off.




W11
24 V: b30/z30
NTC
Motor
Power supply
R5: 25l/h
enable
Water pump
d28
d30
M15
M
b32
z32
Speed
check
Pump release
approx. 5 min
Valve driver
shortcircuit
monitoring
b24
24V
Power
supply
W16B.z18
Park pos.
z18
td
&
z24
Y1
b22
Valve release
V70 on: P
V72 on: P
V71 on: Reg. on
d4
d12
z22
W16B.b8
Open loadY1
W16B.z2
Short circuit Y1
W16B.b10
Overtemp. Y1
offset
R13
MP:
X2.2
X101.d24
Water temp.
SWH
d20
10V
-10V
b16
W16B.b16
Press. too high
V14
≥
offset
R22
MP:
X2.3
X101.d20
Water press.
sensor SWH
b20
b14
W16B.b14
Press. too high
Press. switch
> 800 mbar
+15V
not used
d6
V5
z20
W16B.z4
Press. too low
K2.8
Flow meter
switch S1
z8
Water press.
Water temp.
Water flow ok
V3
d18
W16A.b4
W15.b8
Cool. circ.ok
&
V11
d16
W16B.z8
Cooler defect.
K2.5/S4
Press. switch
800 mbar
d10
≥
V12
z12
W16B.z12
Flowrate too low
< 17l/h
V13
d14
W16B.z6
Flow meter-
defective
W16B.b24
Reset
d24
1
V15
b18
W16B.z16
Temp.too high
> 38 ° C
Error evaluation

*Regulation process*

As already described, the water pressure in the cooling circuit is acquired by the pressure sensor at the shock wave head and is relevant to the application of a regulation process.

Depending on the water pressure, two processes can occur:

- Water is forced back into the reserve tank if p > pnom / Drain process.
- Water is forced by the pump into the cooling circuit if p < pnom / Fill process.

Since the system is inclined to oscillate easily, a time mask is superimposed on the regulation process.

One regulation period equals 32 units (appox. 5 seconds). Of this, 4 can be used for the fill process (p < pnom) and16 for the drain process (p > pnom). A pause follows until the 32 units have expired.

**NOTICE**

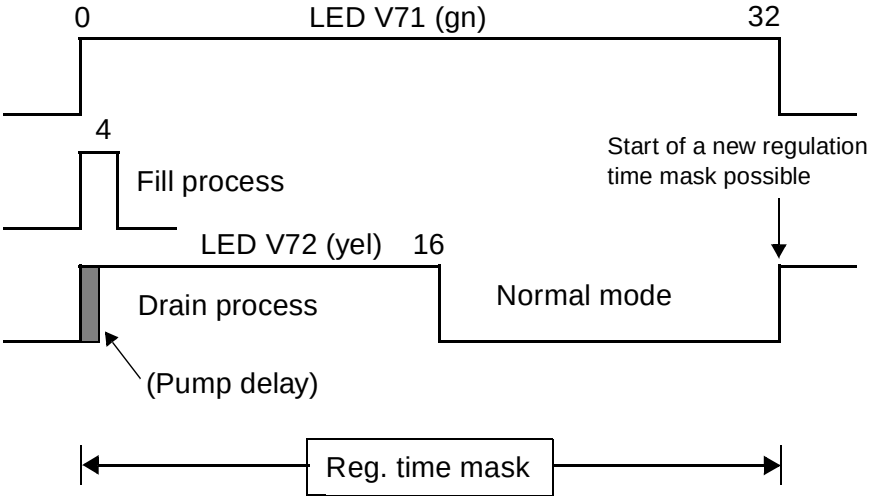
**If the system was empty (initial filling or $p_{min}$ was exceeded), the fill process will run continuously to prevent long waiting periods. The drain process is delayed until the water pump falls below the minimum speed.**

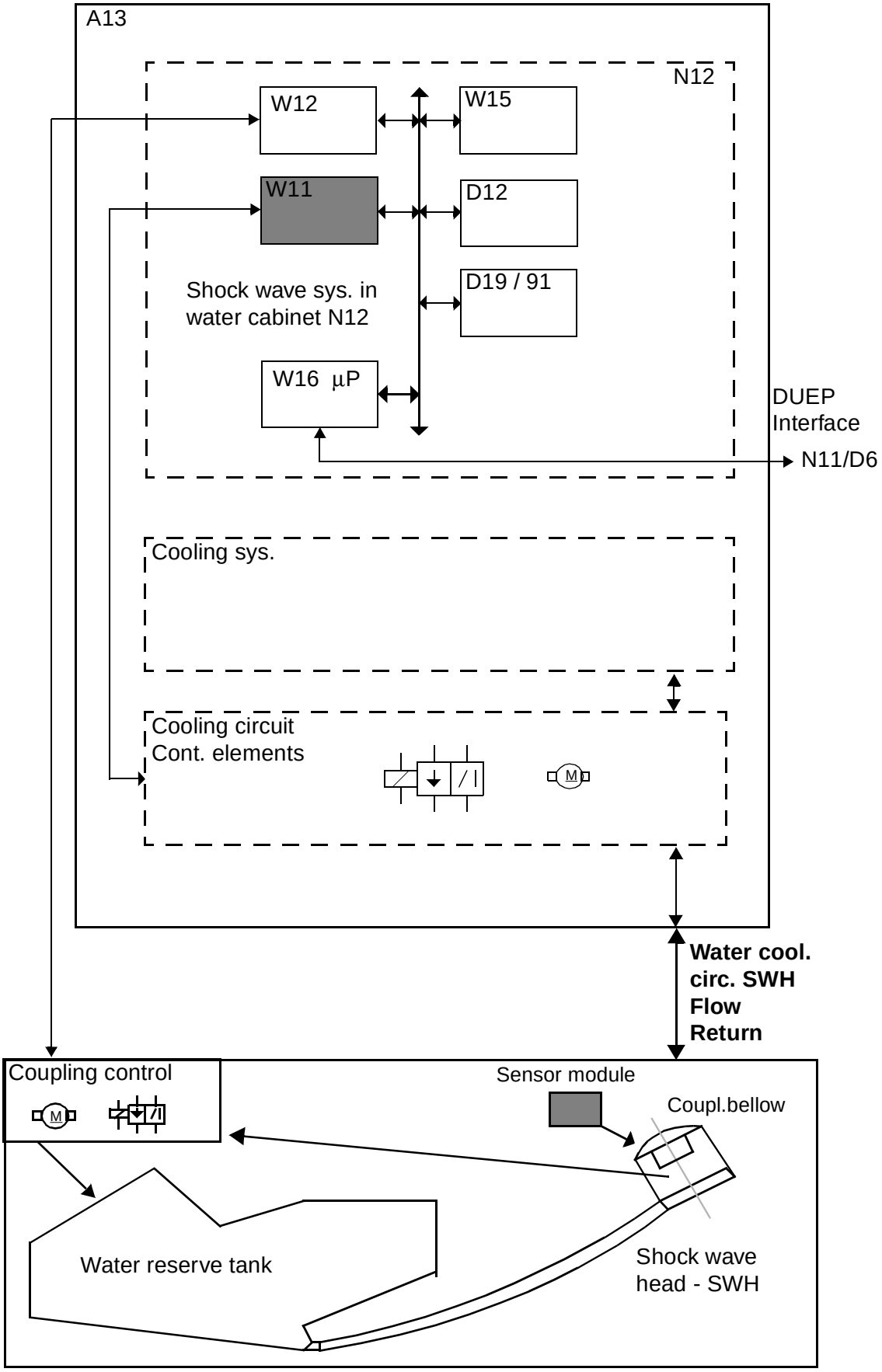
*Displays*

LED V 71 (green): Signals the beginning of a pressure correction in the cooling circuit.

LED V 70 (ye): Fill process. Pressure in the cooling circuit is increased.

LED V 72 (ye): Drain process. Pressure in the cooling circuit is reduced.




A13
N12
W12
W15
W11
D12
D19 / 91
Shock wave sys. in
water cabinet N12
W16 µP
DUEP
Interface
N11/D6
Cooling sys.
Cooling circuit
Cont. elements
M
Water cool.
circ. SWH
Flow
Return
Coupling control
M
Sensor module
Coupl.bellow
Water reserve tank
Shock wave
head - SWH

## Monitoring system

*Shock wave*

The main functions of the shock wave system are the generation and monitoring of a shock wave.
The following components are required for this purpose:

- Control electronics (W15,D12,D19,D91)
- High voltage charging unit (M18)
- Energy unit (N70)
- Shock wave head

*Tasks of the individual components*

**W16:**

- Making the energy level code available for the W15.
- Receipt and forwarding of error messages to the HOST.
- Monitoring the release circuit .

**W15:**

- Converting the energy values selected at the operating PC into KV nominal values for the charging unit M18 (digital)
- Converting the digital KV values for the D19 for monitoring purposes (KV nom analog).
- Monitoring shock wave release.

**D12:**

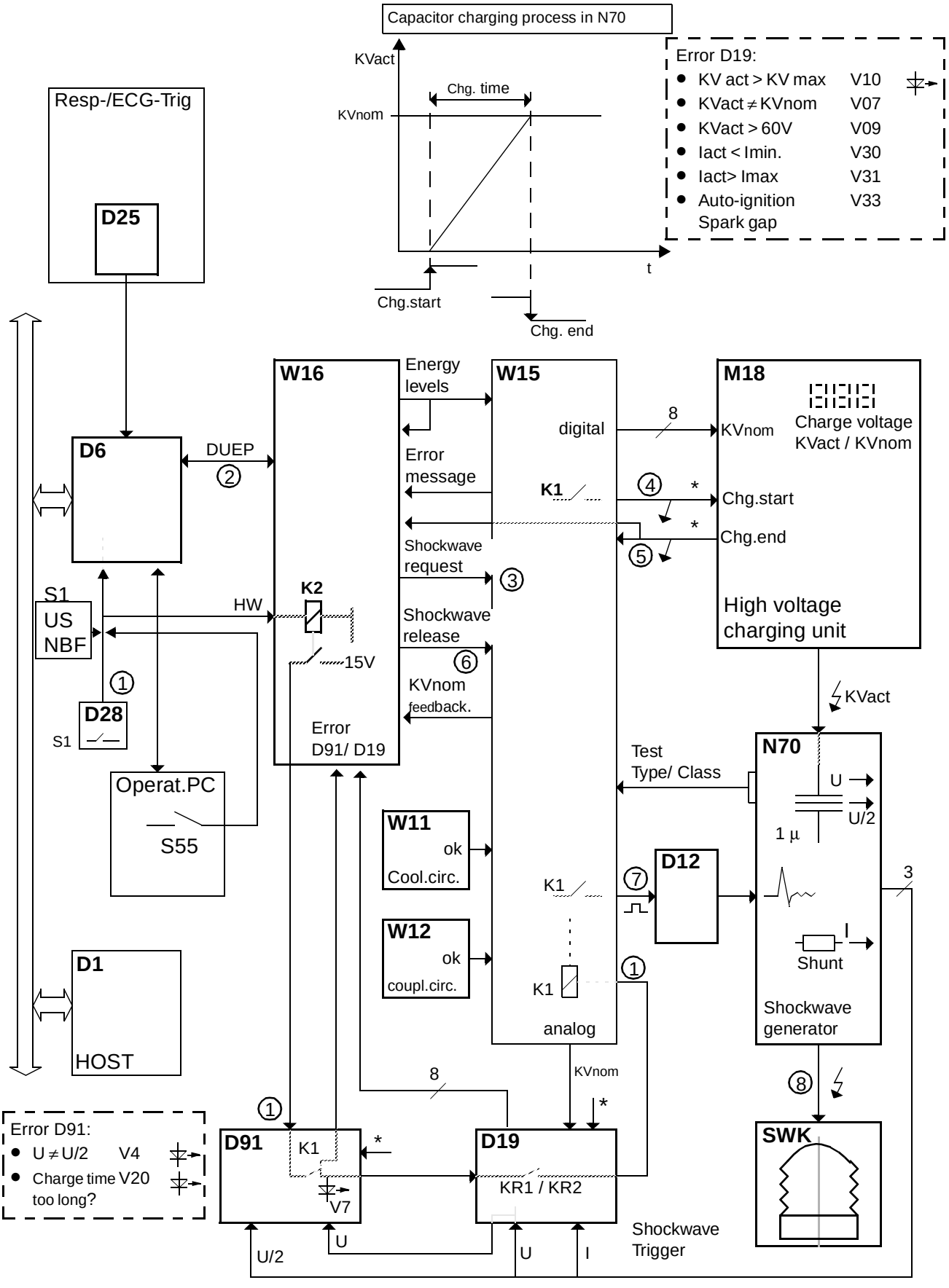
- Converting the 5V trigger pulses for the spark gap to approx. 300V.

**D91:**

- Partial short circuit monitoring of the 1µF capacitor (U/2 =U).
- Charge time monitoring of the 1µF capacitor in the shock wave generator.

**D19:**

- Monitoring the charging voltage of the capacitor with the nominal default (KVnom = KVact) at the end of the charging process.
- Monitoring the discharge current.
  Iact > Inom ? → short circuit and Iact < Isnom ? → interrupt
- Monitoring the discharge-spark gap for auto-ignition
- Monitoring the maximum charging voltage KVact> KVmax ?
- Indicator for the residual voltage in the capacitor, in case it is greater than 60 V act. KVact > 60V ?


Capacitor charging process in N70
KVact
Chg. time
KVnom
t
Chg.start
Chg. end
Error D19:
KV act > KV max V10
KVact ≠ KVnom V07
KVact > 60V V09
Iact < Imin. V30
Iact> Imax V31
Auto-ignition V33
Spark gap
Resp-/ECG-Trig
D25
D6
DUEP
W16
Energy levels
W15
digital
8
M18
KVnom
Charge voltage KVact / KVnom
Error message
K1
Chg.start
Chg.end
Shockwave request
Shockwave release
KVnom feedback.
S1
US NBF
HW
K2
15V
D28
S1
Error D91/ D19
High voltage charging unit
KVact
Operat.PC
S55
Test Type/ Class
N70
U
U/2
1 µ
W11
ok
Cool.circ.
W12
ok
coupl.circ.
D12
I
Shunt
Shockwave generator
analog
D1
HOST
KVnom
SWK
Error D91:
U ≠ U/2 V4
Charge time too long? V20
D91
K1
V7
D19
KR1 / KR2
Shockwave Trigger
U/2
U
U
I

## Block wiring diagram

Releasing a shock wave:

*D28/S1 on ① and ②*

Release switches (D28/S1, US-NBF/S1, S55) on the control panel 24V → D6 of the Com-Controller. Data exchange takes place with the HOST D1 in the Com-Controller. If all systems are working without errors, the release command can be forwarded to the shock wave system via D6. The type of triggering depends on the operating mode selected.

*Resp.- ECG Triggering*

Release signals for Respiratory / ECG Triggering are transmitted from D25. From D6 Com-Contr. → via the DUEP interface → to the system controller. At the same time, the release request goes to W16; this means: ”software and hardware requirements for the release of a shock wave must both be present (dual protection). Relays K2/W16, K1/D91, KR1/2 D19 and K1 W15 are switched on or are correctly set.

③

The system controller W16 verifies the release request and initiates the shock wave release request.

*Shock wave request*

④

If the energy level is acceptable and the cooling and coupling circuits answer "ok", the signal to start charging can be released via relay contact K1 to M18. (D91 and D19 must not indicate errors).
Charging unit M18 charges the capacitor in the shock wave generator to the default KVnominal value. The charging process is monitored by D91 and D19.

⑤ *and* ⑥ *Shock wave release* ⑦

Controller W16 gives the "shock wave release" signal after the end charge signal and generates a trigger signal via W15 to D12. D12 converts this 5V trigger signal to a signal of approx. 300V.

This value is converted again by a factor of 100 in the shock wave generator N70 so that the spark gap can be ignited with this signal.

⑧

The capacitor in the energy unit discharges via the coil of the shock wave head and generates a shock wave.

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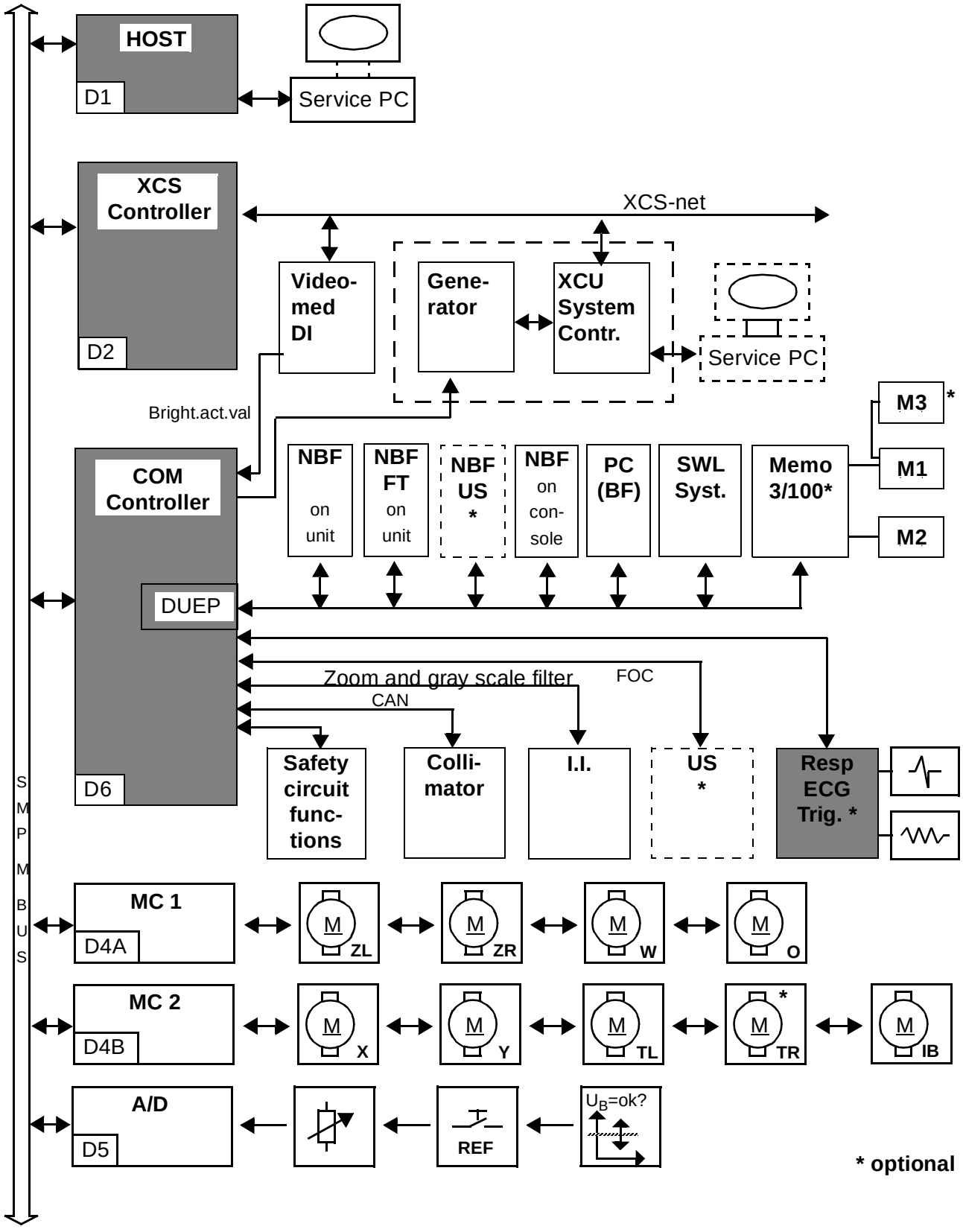
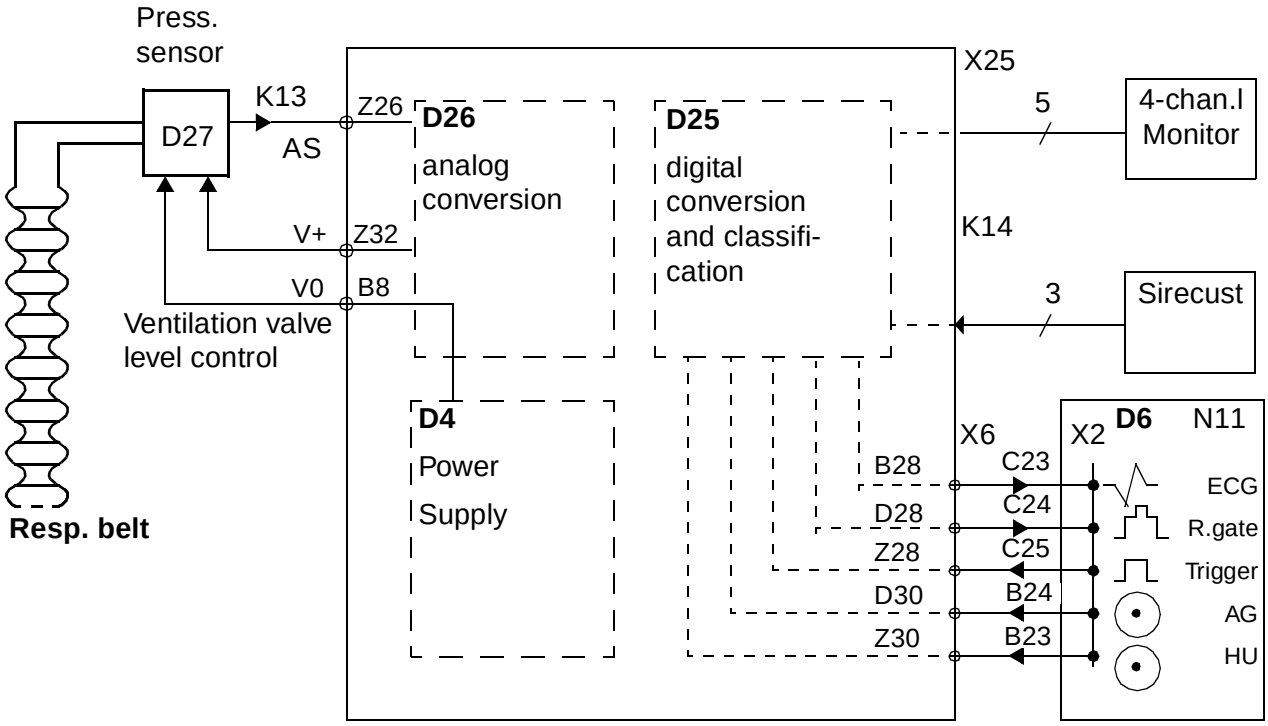

HOST
D1
Service PC
XCS Controller
D2
XCS-net
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
M3
*
M1
M2
COM Controller
NBF on unit
NBF FT on unit
NBF US *
NBF on con-sole
PC (BF)
SWL Syst.
Memo 3/100*
DUEP
Zoom and gray scale filter
FOC
CAN
D6
Safety circuit func-tions
Colli-mator
I.I.
US *
Resp ECG Trig. *
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M TR
*
M IB
A/D
D5
REF
UB=ok?
* optional

## ECG and respiratory triggering block diagram




The respiratory and ECG trigger function unit consists of the boards shown above.

*Operating modes*

At the PC operating console, the Shock wave release operating modes:

- ECG Triggering*
- RespiratoryTriggering* and
- ECG and respiratory triggering together

can be selected.
The ECG signal is generated and allocated by the Sirecust.

*Monitoring*

Board D6 monitors the respiratory and ECG triggering function unit. The following processes are important:

- sending life signs to the HOST
- testing whether the conditions for shock wave triggering are met for the respective operating mode.
- timeout monitoring for respiratory and ECG trigger.

*Option

| NOTICE | **Respiratory and ECG triggering is an option.**<br>**(Refer also to LITHOSTAR Standard Function Description.)** |
|---|---|

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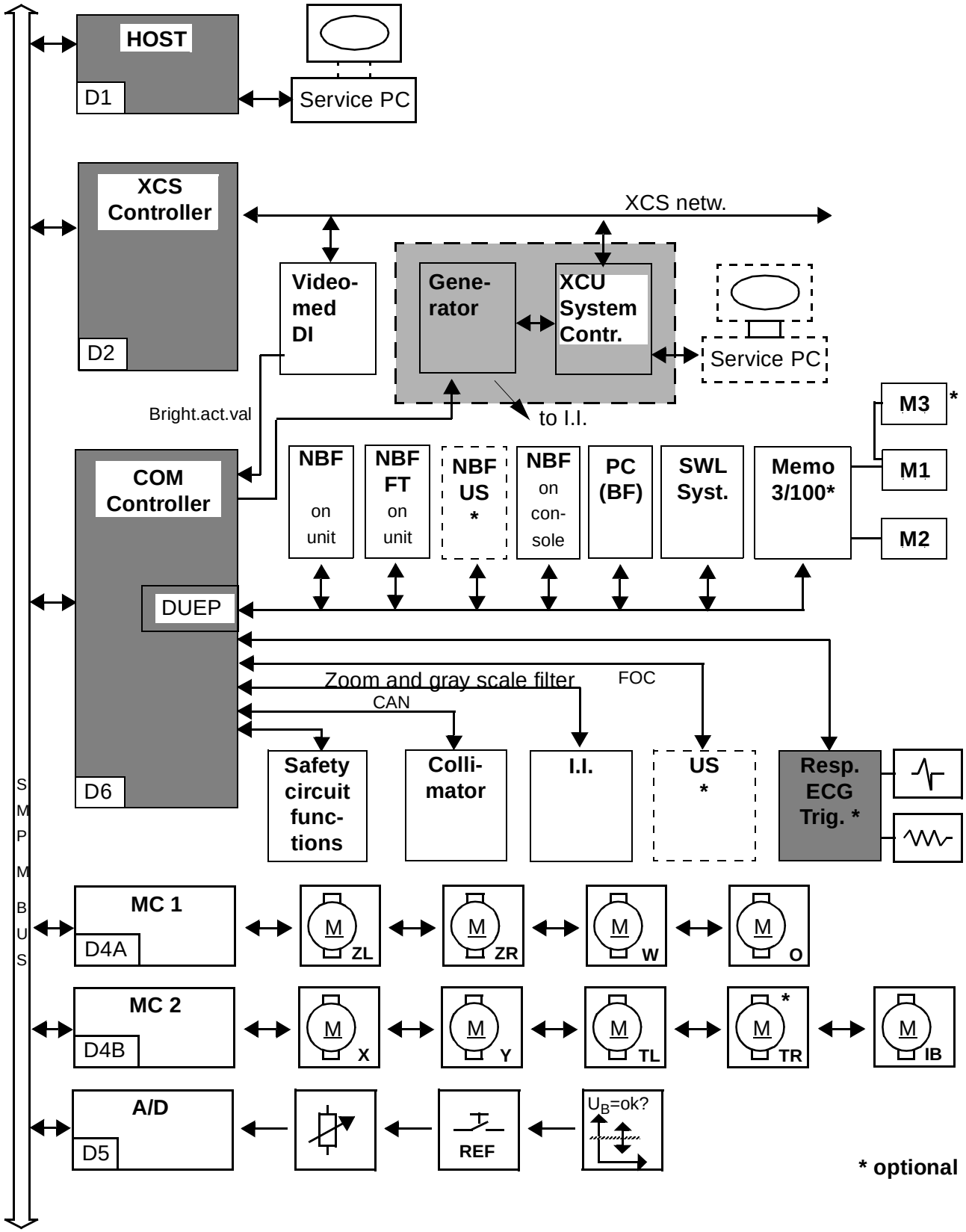

HOST
D1
Service PC
XCS Controller
D2
XCS netw.
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
to I.I.
M3
*
M1
M2
COM Controller
NBF on unit
NBF FT on unit
NBF US *
NBF on con-sole
PC (BF)
SWL Syst.
Memo 3/100*
DUEP
Zoom and gray scale filter
FOC
CAN
D6
Safety circuit func-tions
Colli-mator
I.I.
US *
Resp. ECG Trig. *
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M TR
*
M IB
A/D
D5
REF
UB=ok?
* optional

*Generator console*

In the Multiline system, the generator control panel is integrated into the system control panel (operating PC). This means that the HOST (D1) must simulate the generator control panel for the system controller (D200/D320 XCU). This occurs via the XCS Controller (D2) that communicates with the system controller (XCU) .

*Commands*

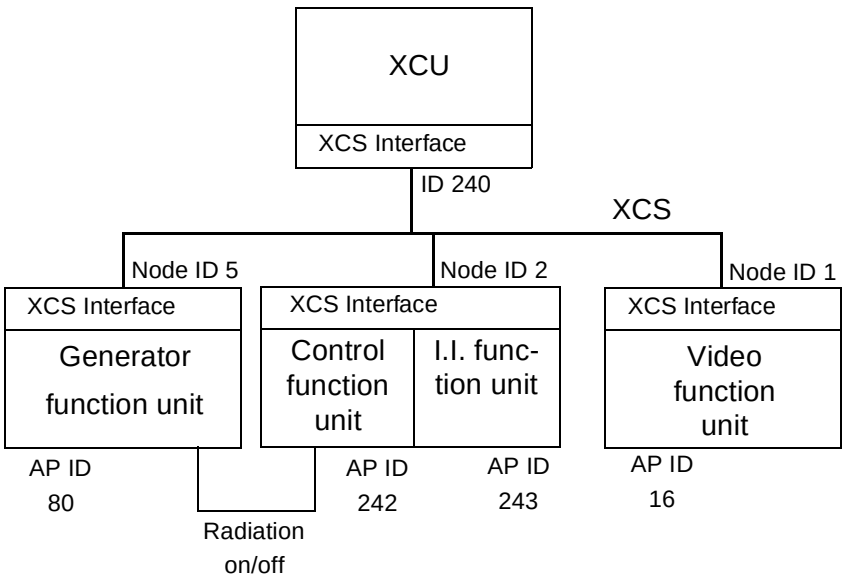
The following information is exchanged:

FL-clock reset, FL-buzzer reset, FL-auto low / high, FL-on

KV-value selection, mAs-value selection, film density value selection, precontact, main contact, direct technique selection, focus small / large, 80% / 100% output, zoom level, image reverse, limit, reset, etc.

*XCS network*

The structure of an XCS network:
This structure applies to all systems and is different only in the number and type of components and the function units allocated.




AP: Application
XCS: Xray communication system
XCU: Xray control unit
FKT.: Function unit
ID.: Identification

Notice: Critical timed signals or signals with dual protection can be conducted via a hardware connection.

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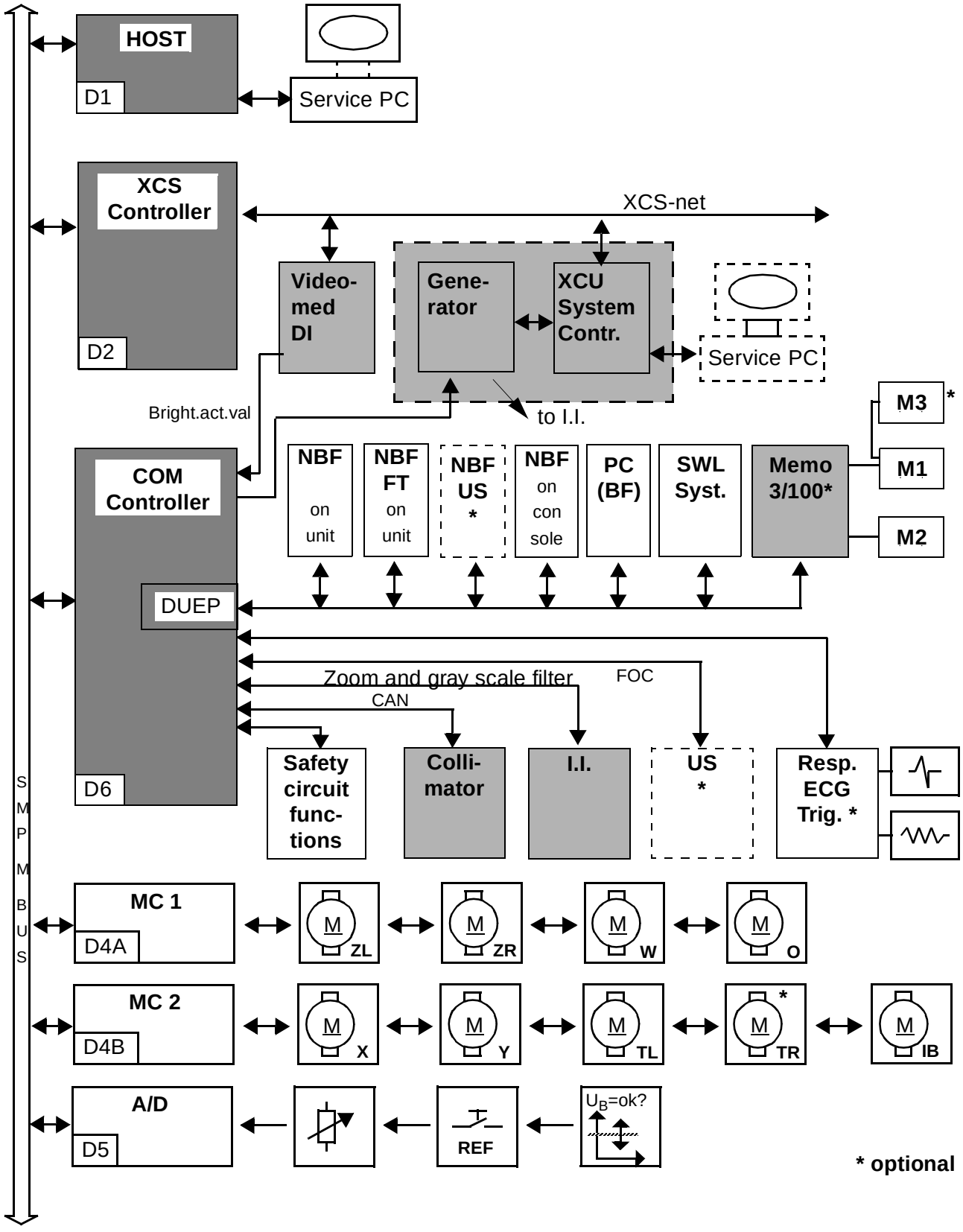

HOST
D1
Service PC
XCS Controller
D2
XCS-net
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
to I.I.
M3
*
M1
M2
COM Controller
NBF on unit
NBF FT on unit
NBF US *
NBF on con sole
PC (BF)
SWL Syst.
Memo 3/100*
DUEP
Zoom and gray scale filter
FOC
CAN
Safety circuit func-tions
Colli-mator
I.I.
US *
Resp. ECG Trig. *
D6
SMPMBUS
MC 1
D4A
M ZL
M ZR
M W
M O
MC 2
D4B
M X
M Y
M TL
M TR
M IB
A/D
D5
REF
UB=ok?
* optional

## Overview

*Associated components*

- X-ray generator including tube and collimator
- Image processing components
- Control components

X-ray generator including tube and collimator

Generates X-rays and collimates the radiation field

Image processing components

Image intensifier

TV-camera head (Videomed DI-M)

(with motor-controlled iris diaphragm)

TV central unit (Videomed DI-M)

Image memory (Memoskop 3/100)

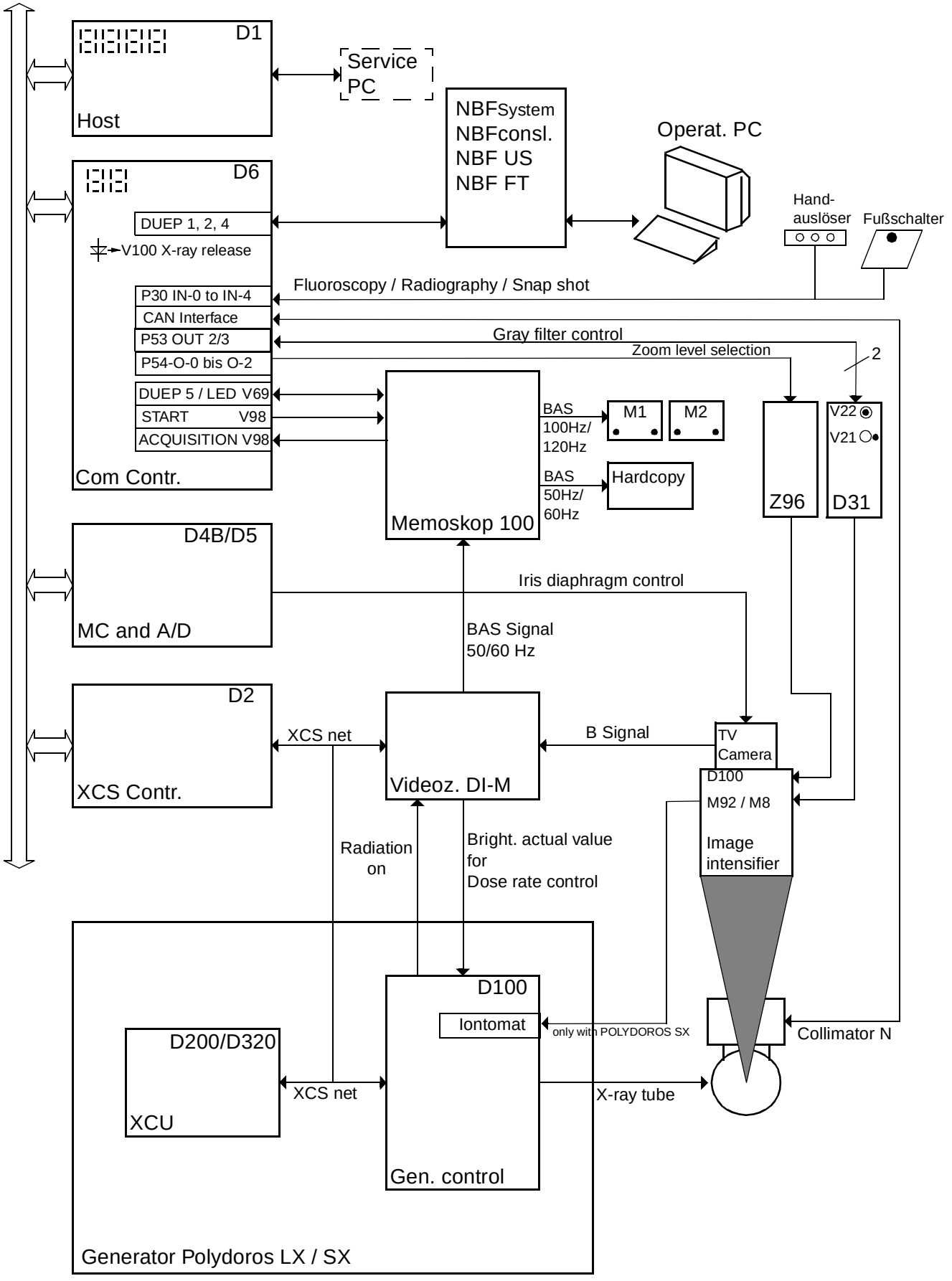
Monitors (M1, M2)

Control components

HOST computer

XCS network with system controller (XCU)

D6 Com. Control with DUEP interfaces


D1
Host
Service PC
NBFSystem
NBFconsl.
NBF US
NBF FT
Operat. PC
D6
DUEP 1, 2, 4
V100 X-ray release
Hand-auslöser
Fußschalter
Fluoroscopy / Radiography / Snap shot
P30 IN-0 to IN-4
CAN Interface
P53 OUT 2/3
P54-O-0 bis O-2
Gray filter control
Zoom level selection
2
DUEP 5 / LED V69
START V98
ACQUISITION V98
Com Contr.
BAS
100Hz/
120Hz
M1
M2
BAS
50Hz/
60Hz
Hardcopy
Memoskop 100
Z96
V22
V21
D31
D4B/D5
MC and A/D
Iris diaphragm control
BAS Signal
50/60 Hz
D2
XCS net
XCS Contr.
Videoz. DI-M
B Signal
TV Camera
D100
M92 / M8
Image intensifier
Radiation on
Bright. actual value for Dose rate control
D100
Iontomat
only with POLYDOROS SX
Collimator N
D200/D320
XCU
XCS net
X-ray tube
Gen. control
Generator Polydoros LX / SX

## Fluoroscopy and Film acquisition

*Preliminary remarks*

The Lithostar Multiline offers the following operating modes for generating images:

- 43cm x 35cm film acquisition with cassette holder
- Fluoroscopy
- Snap shot (for MULTILINE with POLYDOROS SX and 33 cm I.I. only)

(DR Digital Radiography)

*Film acquisition*

At the operating PC, the acquisition kV and mAs values are entered using the exposure tables (2-point technique).
Radiation is then released at the operating console using the hand release switch or the footswitch. The footswitch at the table provides a third release option. Exposure time depends upon the output level selected (100% or 80%) as well as the data entered.

*Fluoroscopy preparation*

On the operating PC, select from:

Fluoroscopy curve (Antiisowatt or 63KV; 1or 2)
zoom level, noise suppression, edge or contrast enhancement, automatic stop.

*Fluoroscopy release*

Fluoroscopy can be released using the handswitch or the footswitch.
The FL request is transmitted directly to the D6 Com controller.
(Port P30 IN0-IN4).

The **D6** Com controller forwards the FL request to the HOST D1.

The HOST transmits a FL request via the XCS-Contr. **D2** and the XCS network to the system controller XCU **D200 (D320** for PSX**).** The request is subsequently forwarded to the generator controller **D100**.

*KV, mA regulation*

Regulation is controlled via the fluoro curve selected and the brightness-actual value (dose rate control) of the TV central (Videomed DIM).

*TV iris diaphragm*

The iris diaphragm opening depends on the system configuration. On the Polydoros LX, it comprises only one aperture whereas on Polydoros SX, (snap shot, 33cm I.I.) it comprises several.

*Radiation feedback*

The radiation feedback signal is transmitted via the XCS network to the HOST.

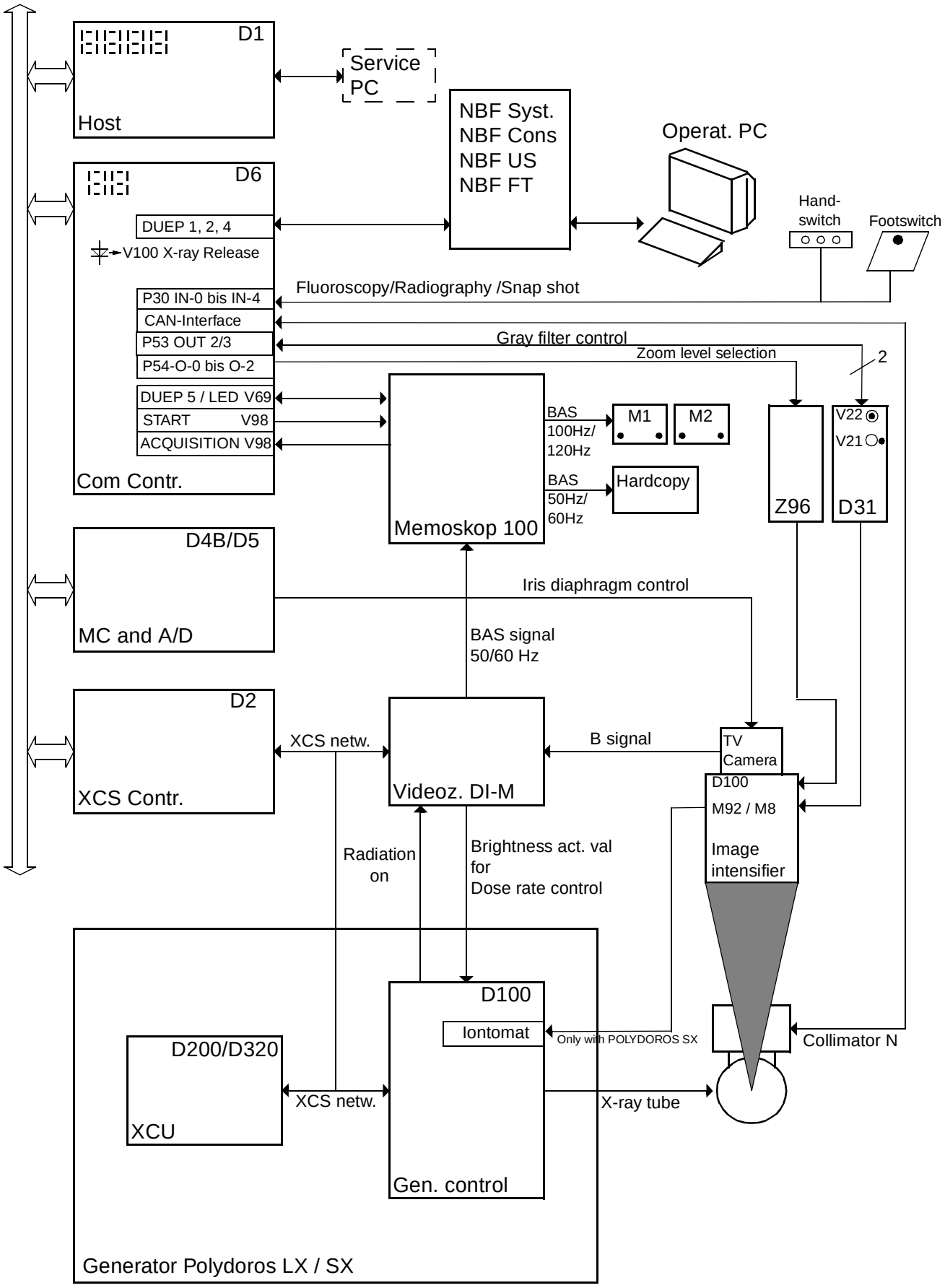
*Image storage*

The goal is to store the image content (B) of the BAS signal and following conversion in the Memoskop 100, to display it on the two 100 Hz monitors.

*Last Image Hold*

On the Memoskop 100, select Fluoroscopy mode and "Last Image Hold." The Memoskop is switched by the Host to Fluoroscopy mode when the radiation

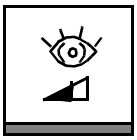
request is received.
After receiving the signal ”Fluoroscopy mode switched on”, the HOST


D1
Host
Service PC
NBF Syst.
NBF Cons
NBF US
NBF FT
Operat. PC
D6
DUEP 1, 2, 4
V100 X-ray Release
Hand-switch
Footswitch
Fluoroscopy/Radiography /Snap shot
P30 IN-0 bis IN-4
CAN-Interface
P53 OUT 2/3
P54-O-0 bis O-2
Gray filter control
Zoom level selection
2
DUEP 5 / LED V69
START V98
ACQUISITION V98
Com Contr.
Memoskop 100
BAS 100Hz/ 120Hz
BAS 50Hz/ 60Hz
M1
M2
Hardcopy
Z96
V22
V21
D31
D4B/D5
MC and A/D
Iris diaphragm control
BAS signal 50/60 Hz
D2
XCS Contr.
XCS netw.
Videoz. DI-M
B signal
TV Camera
D100
M92 / M8
Image intensifier
Radiation on
Brightness act. val for Dose rate control
D100
Iontomat
Only with POLYDOROS SX
Collimator N
D200/D320
XCU
XCS netw.
X-ray tube
Gen. control
Generator Polydoros LX / SX

waits for the ”Radiation on” feedback signal from the generator and then gives the START signal.

*Memory ”START”*

During Fluoroscopy (Live signal on the monitor), the Memoskop100 performs sliding weighted averaging.



The averaging depends on the noise suppression level selected.

| | |
|---|---|
| Noise suppression off | : 2 images are integrated |
| Level 1 selected | : 4 images are integrated |
| Level 2 selected | : 8 images are integrated |

*Acquisition*

The feedback signal ”memory active” is sent via the Com Contr. D6 to the HOST D1 via the acquisition signal.

*Fluoroscopy off*

When the radiation hand switch (or footswitch) is released, (no longer activated), the HOST receives the message "Fluoroscopy off."
The HOST cancels the START signal to the Memoskop100, waits for the acquisition signal to be withdrawn and then forwards the ”Fluoroscopy off” message via the XCS network to the Polydoros generator.

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## Snap shot (optional)

*"DR" selection*

At the operating PC, select / F10, DR menu.

Two levels, high / low, can be selected.

*Release*

Press the release key at the operating console or on the footswitch.

*Sequence*

A DR request is issued by the operating system.

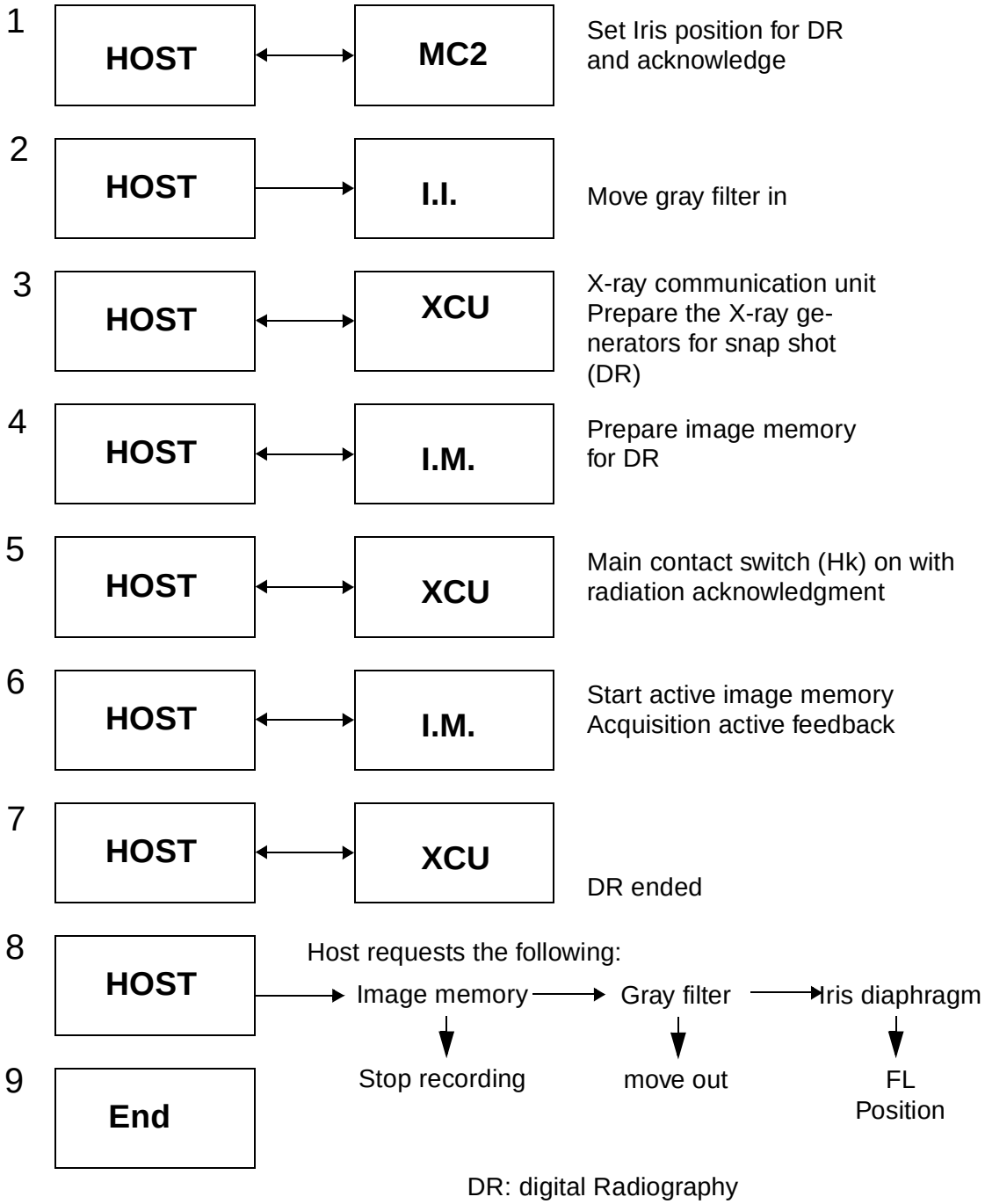
The gray filter is moved in with precontact and the TV iris is closed to the DR format to filter light coming from the I.I. output window.

(VK / HK, refer to the left side)
The following actions occur between steps 5 and 6:
When radiation is switched on, a bright image is produced on the output screen of the image intensifier. In proportion to the brightness of the output screen, the PDA sensor (photo diode array) generates a signal that is forwarded to the Iontomat unit of the generator and which shuts off radiation once the nominal dose amount has been reached.

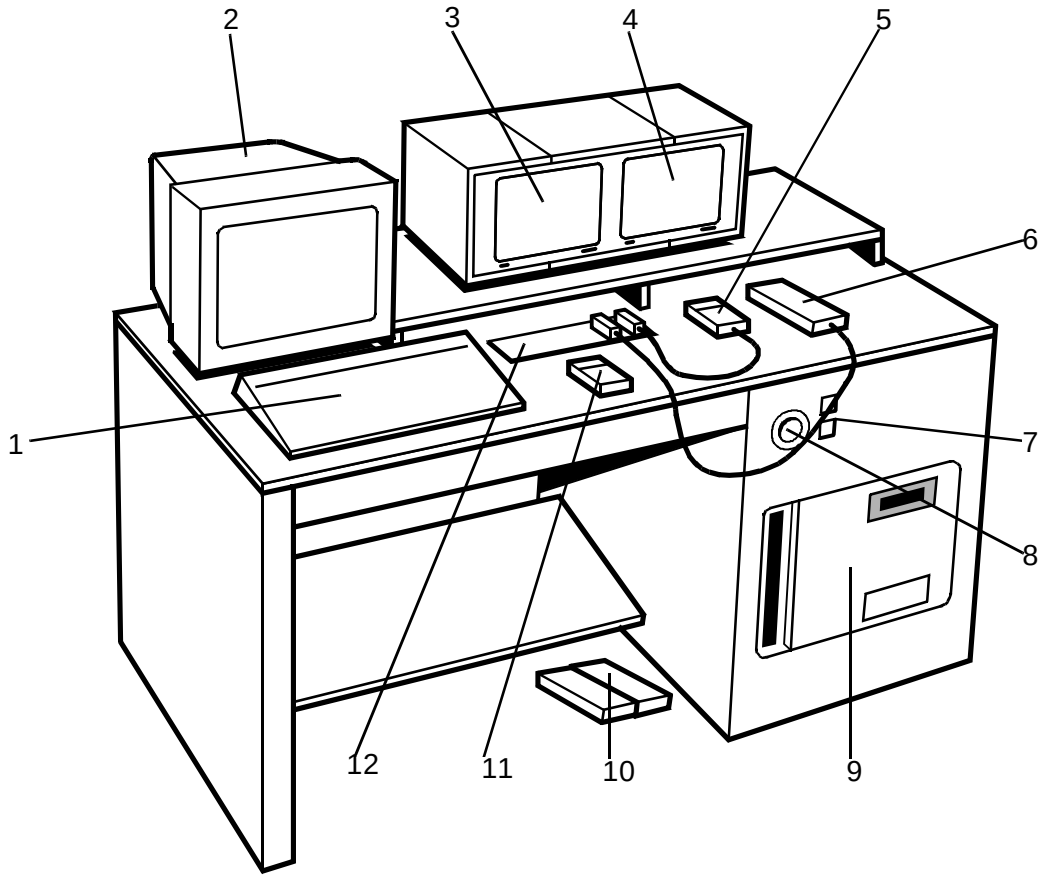
While radiation is on, read-out of the CCD chip is blocked and information is loaded onto the CCD chip in the TV camera.

When radiation is shut off, the image on the CCD chip is read out and filed in the image memory.

Snap shot: chronological flow in basic steps.




DR: digital Radiography




1 Keyboard
2 Operating monitor(PC monitor)
3 Live-X-ray monitor(A)
4 Reference monitor (B)
5 Shock wave release
6 Tableside control
7 System on/off switch
8 STOP switch
9 Multiformat camera (option)
10 Footswitch for Fluoroscopy and Radiography
11 Mouse
12 Connector panel

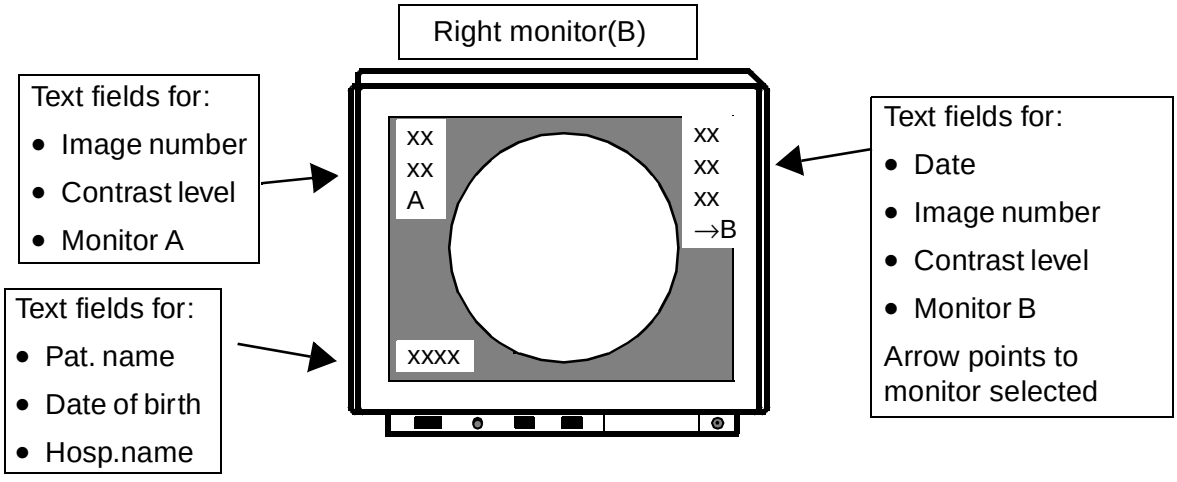


**Image display**

*100Hz/120Hz Monitors*

100 Hz monitors are used with the Lithostar Multiline for displaying images.

Urology operating mode:

The live monitor (A) displays the fluoroscopic image (with DL on).
The LIH stored image is displayed with fluoro off. Monitor B displays the stored image selected.

Therapy operating mode:

The live monitor(A) and the reference monitor (B) display the current fluoroscopic image at -10° and 0° with fluoro on. In the 30° C-arm position, monitor B displays the -10° stored image and monitor A the 30° live or other stored image from the Memoskop 100.

*Superimposed text on-screen*

The Memoskop 100 superimposes the following on the monitors:

- Monitor selected
- Patient data
- Contrast level selected
- Stored image number

*Stored images*

The Memoskop 100 stores a maximum of 100 complete images which the user can access by "paging" forward or backward.

*Image manipulation*

The stored images are displayed on the monitor selected and can be manipulated using the electronics of the Memoskop 100 in the following ways (applies to the respective monitor selected):

- contrast adjustment in four levels
- noise suppression in three levels
- edge enhancement on/off.

| NOTICE | **100 test images are stored in the Memoskop for adjustment purposes. They can be called up via the service program.** |
|---|---|

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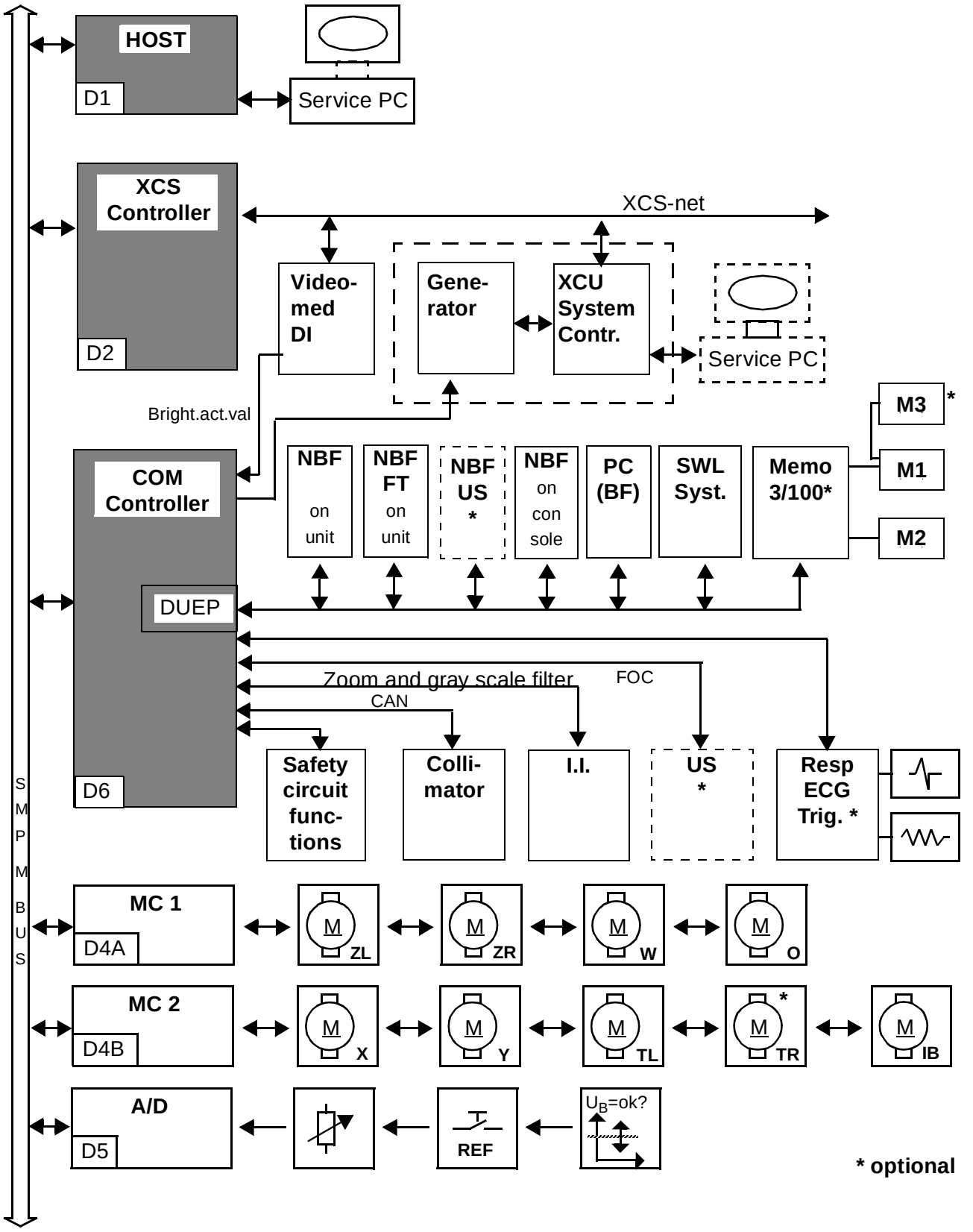

HOST
D1
Service PC
XCS Controller
D2
XCS-net
Video-med DI
Gene-rator
XCU System Contr.
Service PC
Bright.act.val
COM Controller
DUEP
D6
NBF on unit
NBF FT on unit
NBF US *
NBF on con sole
PC (BF)
SWL Syst.
Memo 3/100*
M3 *
M1
M2
Zoom and gray scale filter
FOC
CAN
Safety circuit func-tions
Colli-mator
I.I.
US *
Resp ECG Trig. *
S M P M B U S
MC 1
D4A
MC 2
D4B
A/D
D5
M ZL
M ZR
M W
M O
M X
M Y
M TL
M TR *
M IB
REF
UB=ok?
* optional

***General***

Kidney stone localization is performed with the LITHOSTAR Multiline (Version 4) using X-rays and ultrasound imaging. Ultrasound localization is known as the "Inline" process and X-ray localization as the "Outline" process. Inline means: the Inline LITHO ultrasound probe is mounted in the cone of the shock wave head, therefore in the symmetry axis.
For localization and positioning of a kidney stone, the cone (ultrasound probe) can be rotated and moved in the longitudinal direction. This is controlled from the Ultrasound tableside control panel.

*Components*

1 SONOLINE Prima SLC (1 Sector and 2 linear/convex connector positions)

1 Sector probe CDA 3.5 MHz cast (cone probe)

1 Hand probe (convex)

1 Footswitch (freeze; target on/off)

1 Standard gray scale image monitor

1 Ultrasound control panel (can also be connected to the patient table)

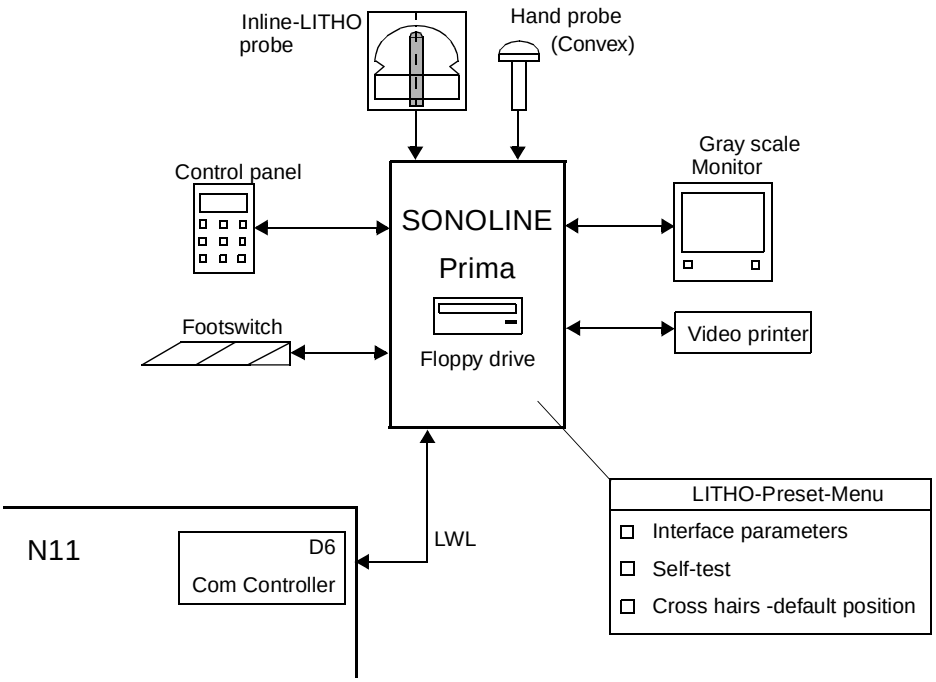
1 Video printer (Hardcopy)

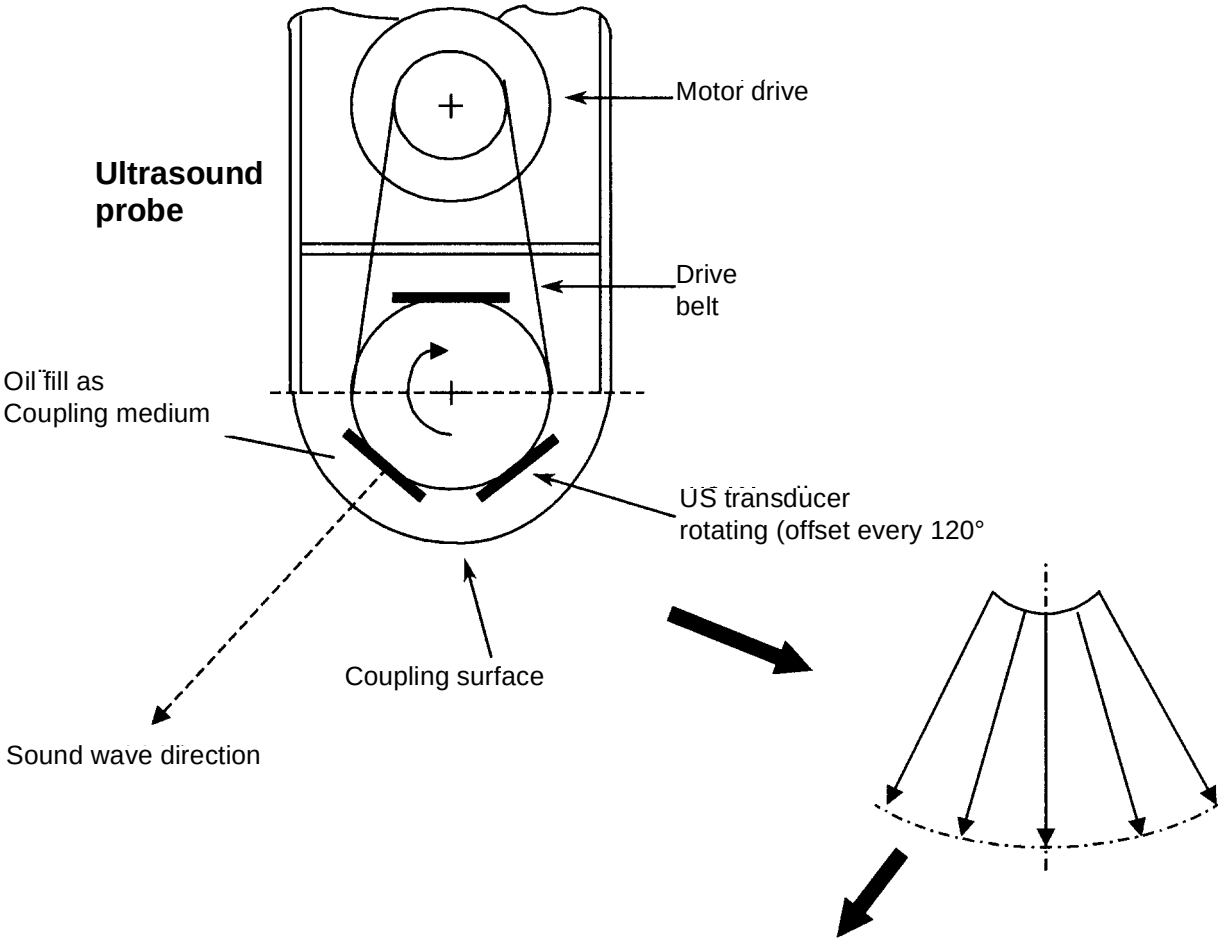
*Interface*

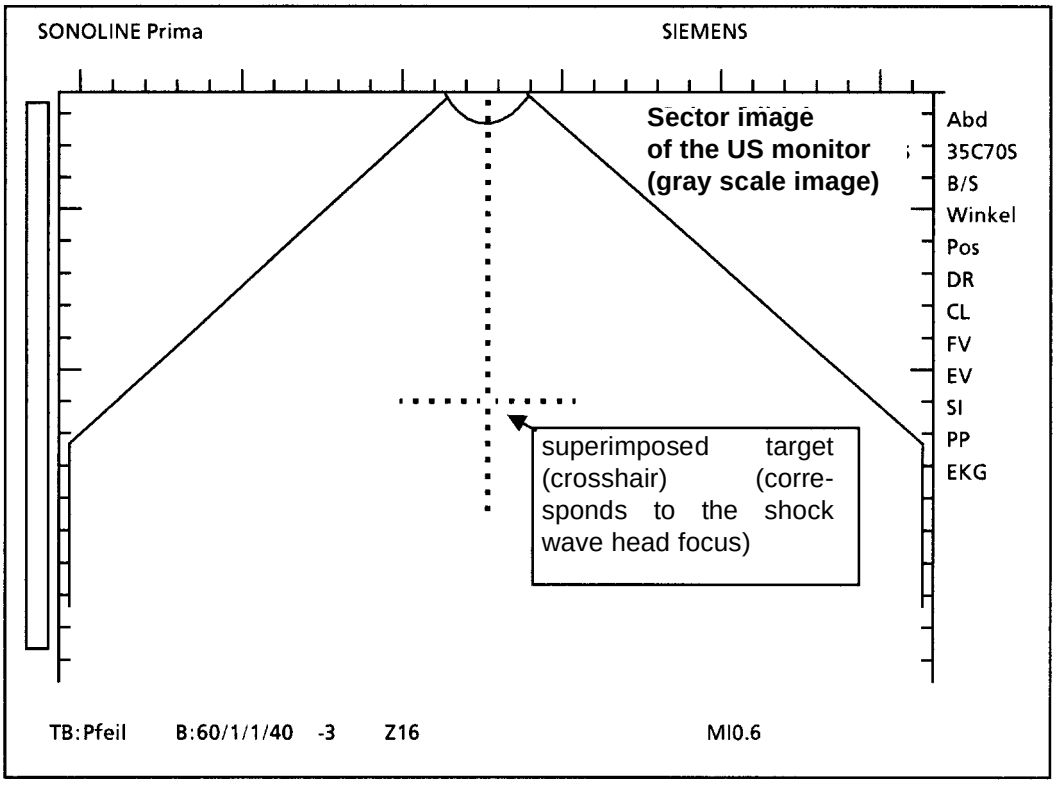
Serial interface (Opto-RS232 fiber optic cable) between the communications controller D6 (U1, U2) and the Sonoline Prima.

When the Multiline system switches on or is in Standby mode, the processor checks functionality of the interface and sends an error message in the event of a malfunction (refer to the error list).

The processor checks whether the probe is connected and whether therapy mode has been selected.




Ultrasound probe
Motor drive
Drive belt
Oil fill as Coupling medium
US transducer rotating (offset every 120°
Coupling surface
Sound wave direction


SONOLINE Prima
SIEMENS
Sector image of the US monitor (gray scale image)
Abd
35C70S
B/S
Winkel
Pos
DR
CL
FV
EV
SI
PP
EKG
superimposed target (crosshair) (corresponds to the shock wave head focus)
TB:Pfeil
B:60/1/1/40 -3
Z16
MI0.6

*Ultrasound probe*

The ultrasound probe acts as the transmitter of ultrasound waves and also as the receiver of the echoes.

Important features are:

- Frequency
- Sound wave characteristics (Focussing)
- Ultrasound output

*Sector scan*

With sector scan, the US conversion elements rotate about an axis (in the simplest sense, a conversion element).

This means:

The Ultrasound pulse can be transmitted and also received in various directions. These position changes lead to a corresponding radial arrangement of the image lines in a sector-like scheme. This is where the name "sector scan" came from.

*Ultrasound probe storage*

A storage compartment is located on the right side of the shock wave head support. The compartment contains a pad for cleaning the probe.

*Ultrasound monitor*

Also called gray scale monitor (brightness). A cross hairs target is automatically superimposed on the monitor display in Lithotripsy mode. The position of the cross hairs target corresponds to the focus of the shock wave head. To ensure optimum image quality, the focal area of the ultrasound field is located there as well.

If the ultrasound probe is moved in the longitudinal direction, the cross hairs target must also follow. The shock wave source focus remains constant.

*Cross hairs on / off*

The superimposed cross hairs target can be switched on or off with the "SET-key" button or with the footswitch.

*Distance measurement*

The distance between the US probe surface and the cross hairs target can be checked with an electronic measurement device. The SONOLINE has a "MEASURING ON key" to turn this option on and an ESCAPE-key to turn it off.

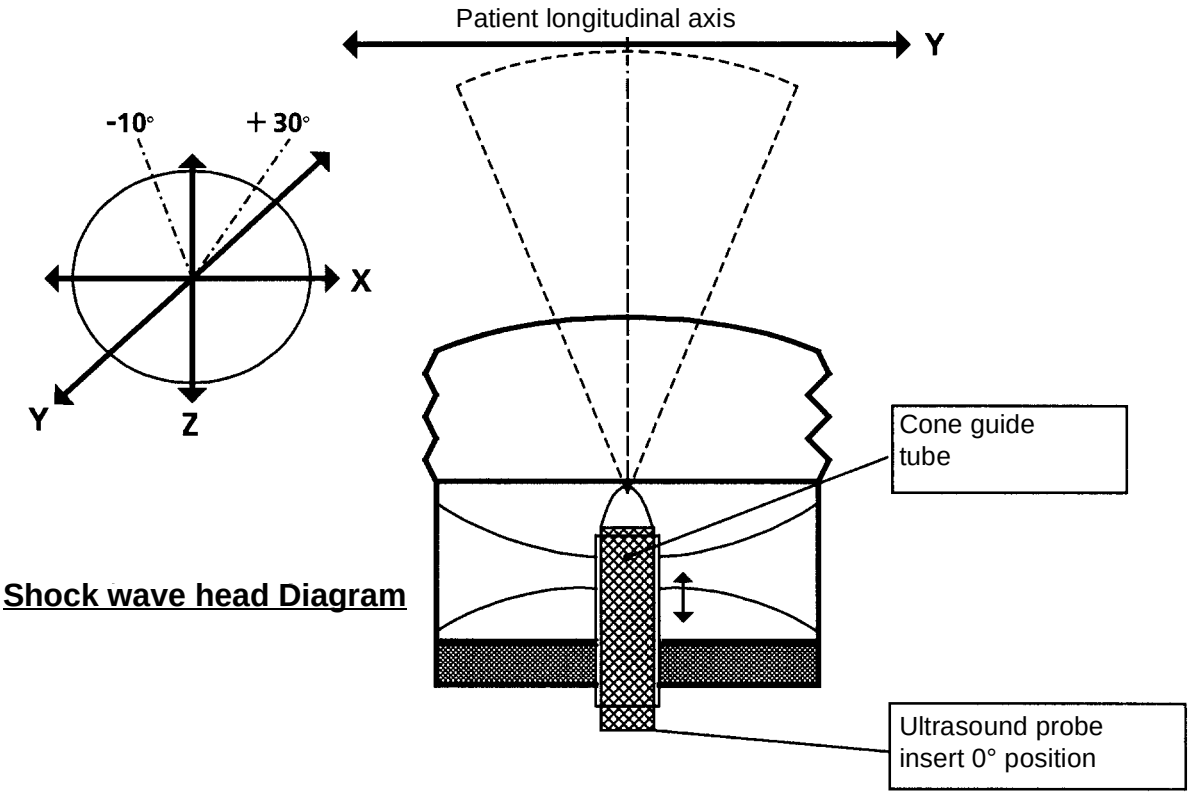
*Software*

The SONOLINE Software can be loaded via a floppy drive

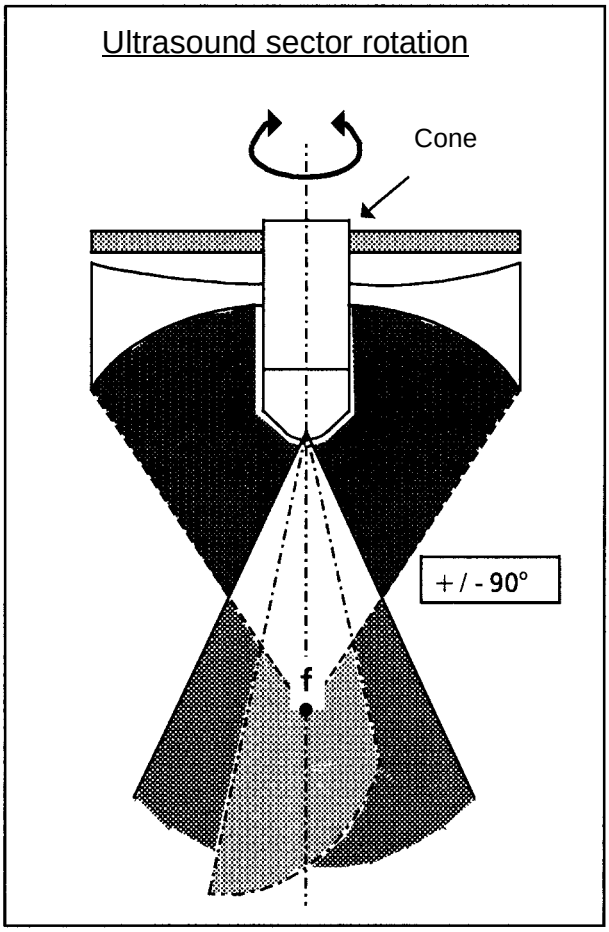
The configuration is established in the LITHO-Preset-Menu.

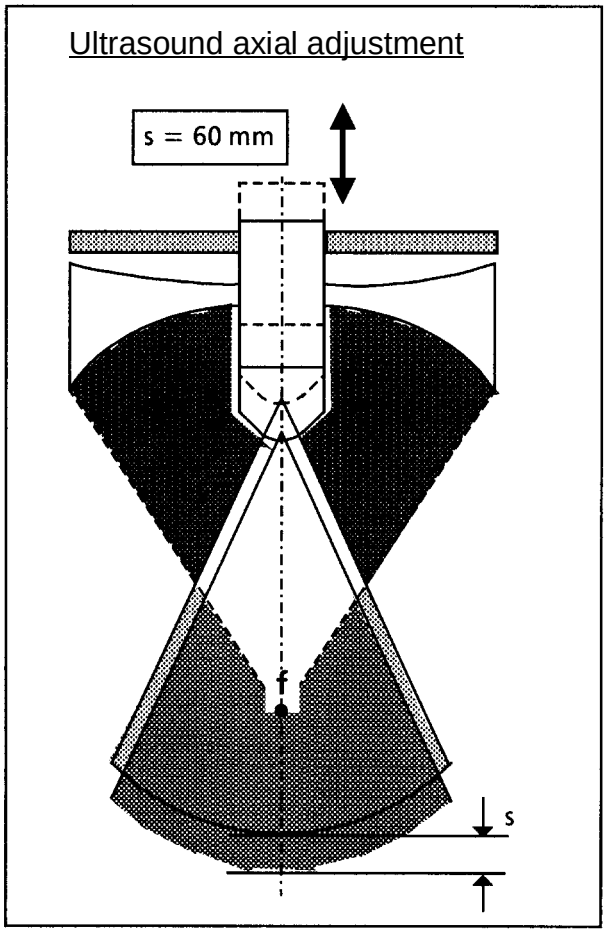
*Notice*

The test for the fiber optic cable can also be called up in the LITHO Menu.




**Shock wave head Diagram**



*Localization*

Kidney stone localization is performed via the ultrasound probe which is centrally mounted in the shock wave head. (Gray scale image mode).

The shock wave focus position is indicated by superimposing a target (cross hairs) in the gray scale image of the US monitor.

Superimposition occurs automatically

- when selecting the US probe integrated in the shock wave head at the Sonoline.
- when inserting the Inline LITHO probe in the shock wave head cone.

The position of the superimposed cross hairs target depends upon the position of the integrated US probe.

*Target*

Focussing the kidney stone in the cross hairs target superimposed in the US monitor can be done by utilizing the following motorized movement options:

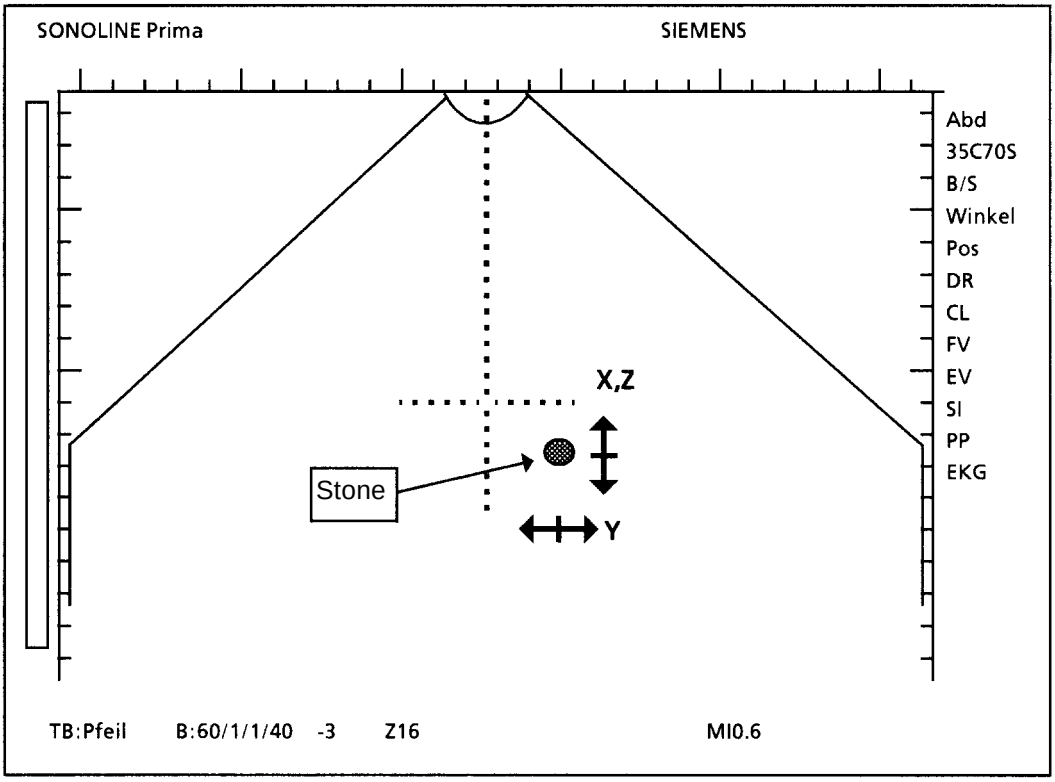
- Localization of the stone by rotating and moving the ultrasound field in the longitudinal direction.
- Fine positioning of the stone in the X,Y and Z direction so that it is located in the cross hairs target.

*Notice*

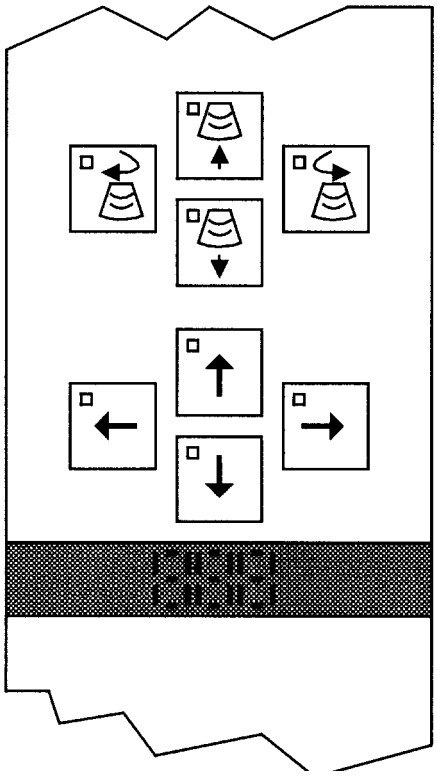
Shock waves can only be released once the proper coupling pressure has been attained.

After inserting the Inline LITHO probe in the US gel position, the probe is positioned at 0 degrees. This means: sector rotation is running parallel to the patient longitudinal axis.

Sector image
of ultrasound monitor
(gray scale image)




Cross section:
Ultrasound
tableside controll



Ultrasound
probe movements

Fine positioning in x, y
and z direction

*Sequence* For the treatment sequence, refer to the Operating Instructions "In-line Ultrasound localization system."

Diese Seite wurde bewußt leer gelassen.

| | |
|---|---|
| Cover sheet and table of contents | revised |
| Chapters 1 -11 | revised |
| Chapter 12 | revised |

TDF 1 / Kneisl

SMS Iselin

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